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Castings Aid Intercontinental Telephone Communication

IF anyone had predicted a century ago that within the following 100 years an apparatus would be invented by which people in the United States could talk to their friends or business associates in Europe or South America, he would have been burned at the stake. Fifty years ago the tele-

Castings Are Used in Construction of Both Long Distance and Local Exchanges

phone was in the process of development and it is only within the past few years that the radio telephone has been realized. Now regular telephone service is available from practically all large cities in the United States to Europe and South America. The business man may calmly sit in his office, pick up the telephone, ask for long distance and talk to almost any place in the world. The American Telephone & Telegraph Co., New York, has inaugurated South American service as its most recent development. For South American communication, four stations are necessary, two in the United States and two a few miles from Buenos Aires, Argentina. The two channels are brought together at the long distance offices in New York and Cuyo, the overseas terminal for Buenos Aires. Many castings are used in the construction of the apparatus used in the various stations required for intercontinental communication. Castings are utilized as brackets, gear boxes, gears, lugs, switch frames, power generating machinery, and elsewhere.

Find Where Castings Can Be Sold

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Preventing In Bronzes

Fig. 1—Tin, 12 and Zinc, 6 Per Cent Bronze Showing Pronounced Incipient Shrinkage, 100 Diameters

EASE of obtaining sound castings varies according to the type of metal used. Metals which possess good fluidity and low contraction, which pour clean and are not gassed easily are easiest to cast sound. The main foundry difficulty encountered in production of sound bronze and red brass castings, including copper-tin, copper-tin-zinc, and copper-tin-zinc-lead alloys is trouble from internal sponginess or porosity. The seriousness of the problem depends a great deal on the degree of soundness which must be attained. Some types of castings may not need to be internally sound and free from porosity, as long as the surfaces of the castings are clean and sharp. However, castings which are to withstand pressure must be free from porosity. Naturally, the demands upon the casting and the metal become more severe as the pressures are raised, and the removal of skin by machining imposes a still greater necessity for intrinsic soundness in the material.

The problem of porosity is general. Nearly all nonferrous foundries have had trouble at one time or other and it is no exaggeration to say that it is a real problem in 80 per cent of the nonferrous foundries. However, it is only within the past 10 years that much thorough research has been devoted to this particular problem, and still more recent that enough data seems available to draw any logical conclusions. This may be due partly to friction between the old time foundryman and the metallurgist and partly to other causes including the maintainence of secrecy in the nonferrous trade. Some results are shown by the fact that there are 600 alloys where possibly 30 would do, many useless patents, and innumerable fluxes and nostrums.

For a number of years the more general cause of porosity in bronze castings was believed to be oxidation of the metal, which made it spongy and porous. Of course, other causes such as dirt, sand, localized shrinkages, blowholes, coldshuts, etc. may cause porosity. However, porosity from these latter sources generally is localized, whereas the *oxidation* porosity apparently is well distributed over large areas. Fracture of such metal frequently shows a darkened reddish to chocolate appearance, quite distinct from the yellow to golden color of sound bronze or light gray of some leaded bronzes. That discolored fracture was known as an

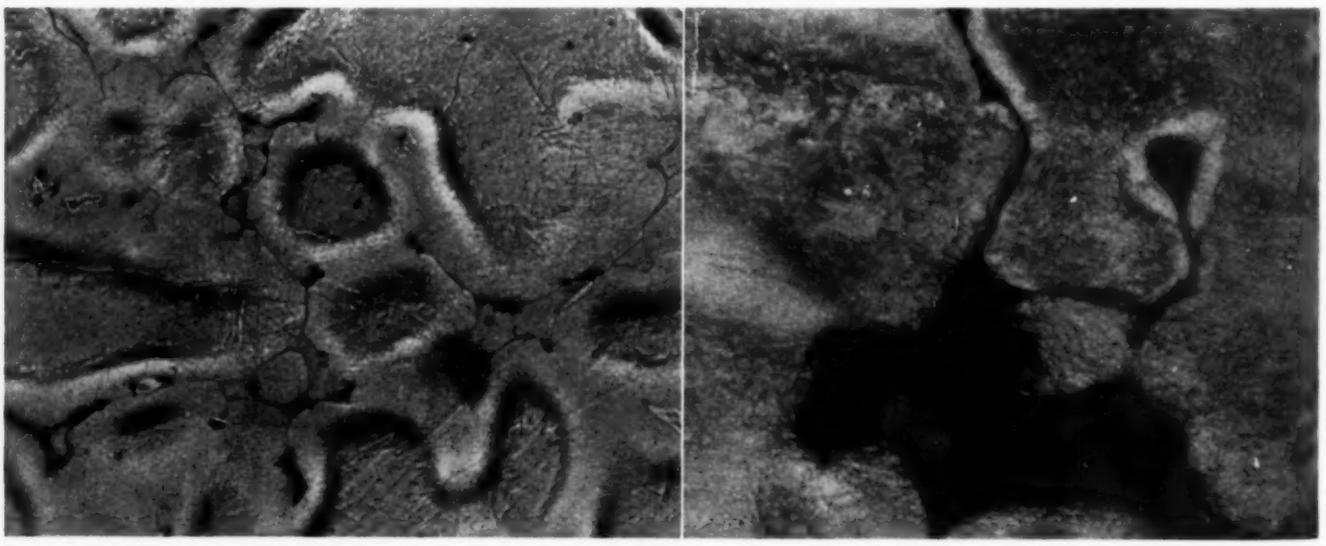


Fig. 2—Incipient Shrinkage in Gun Metal According to Comstock. Etched With Ammonium Hydroxide and Peroxide, 400 Diameters. Fig. 3—Pronounced Incipient Shrinkage According to Bolton and Weigand in Navy G Bronze from a Pump Casting. Etched With Ammonium Hydroxide and Peroxide, 500 Diameters

Unsoundness and Red Brass

Fig 6—Incipient Shrinkage Showing Fine Network Formation. Lightly Etched 100 Diameters

oxidized fracture. Porosity causes the metal to be weak and relatively brittle. In extreme cases large engine bushings have been examined on which small reddish spots appeared on the machined surface, and due to the great unsoundness it was next to impossible to obtain a nice smooth finish on the castings.

Foundrymen have noted that some alloys seem to be more susceptible to this *disease* than others. Further, some held that virgin metals often gave sounder castings than mixtures of remelted metals. Crucible meltings in many cases gave better results than gas or oil-fired open flame furnaces. The advent of various types of electric arc furnaces was hailed with acclaim, because it was felt that oxidation was not possible under the conditions of operation, which practically excluded an oxidizing atmosphere. To the great surprise of many, sometimes the arc furnaces gave bad results. On the other hand many thousands of tons of good castings have been made in electric furnaces.

Before investigating the causes of porosity it is well to study the nature and appearance of the defective metal. Its color and weakness have been referred to previously. However the microscope reveals the true nature of the defective metal. As shown in Figs. 1, 2, 3, and 6, porous metal shows intercrystalline films or fissures, which may be slight as shown in Fig. 2 or quite coarse as depicted in Figs. 1 and 3. The true nature of these networks was not clearly understood for several years.

Comstock in the *Transactions* of the American Institute of Mining and Metallurgical Engineers, 1919, showed that true oxides do not resemble these fissures as is shown in Figs. 4, 5, 7, 8, 9 and 10. He said, "The oxide films so frequent in commercial bronze may be caused either by the volatile oxides of zinc or phosphorus or by dissolved gases thrown out of solution when the metal solidifies." That is, the networks are not truly oxide crystal segregations. Later Woyski and Boeck in the *Transactions* of the American Institute of Mining and Metallurgical Engineers, 1923, said, "Gas and shrinkage cause porous metal and intercrystalline fissures." Thus two opinions are possible (1) that the networks are films or (2) that they are intercrystalline fissures.

Bolton and Weigand in the *Transactions* of the American Institute of Mining and Metallur-

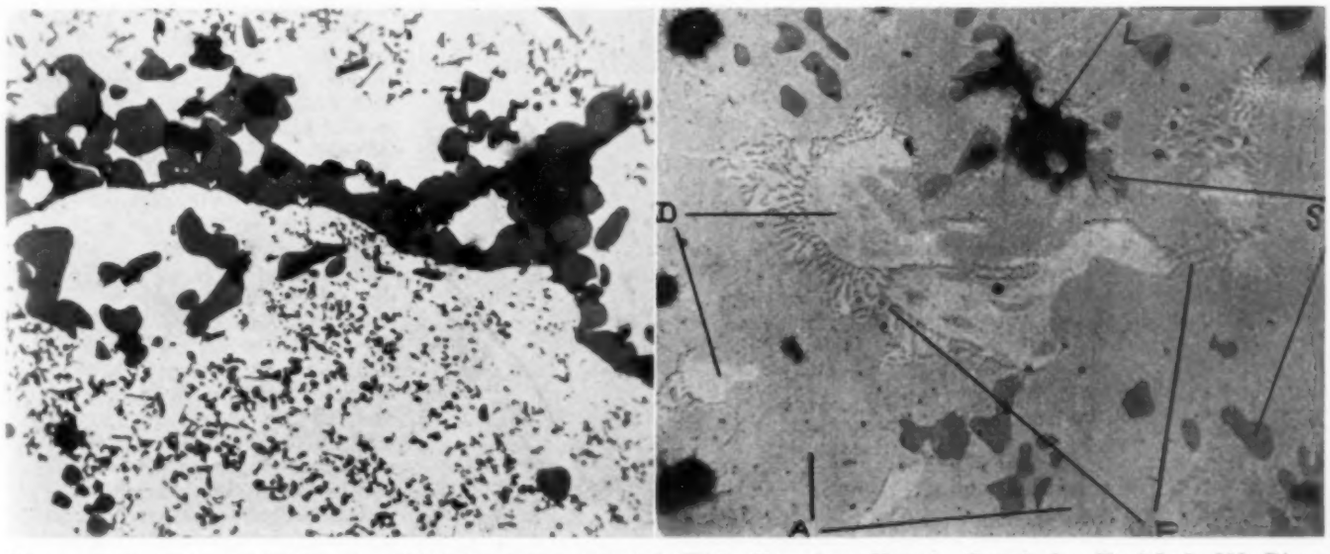


Fig. 4—Zinc Oxide Inclusions in Oxidized Copper Treated With Zinc According to Comstock. Unetched, 200 Diameters. Fig. 5—Phosphor-bronze Showing Black Spots of Lead (L); Dark Gray Sulphide (S); Bright Delta Constituent (D), and Light Phosphide (P) Standing in Relief According to Comstock. Unetched, 400 Diameters

gical Engineers, 1929 and 1930, showed quite definitely that the networks are fissures and not occluded oxide films. Fig. 11 shows the relation between strength and specific gravity. Inasmuch as Karr and Rawdon, bureau of standards *Technical Paper* No. 59, and later Bolton and Weigand, among others, have pointed out that the tensile strength is inversely proportional to the amount of networks in a given alloy, it follows that more networks mean lower specific gravity. Consequently the networks are intercrystalline fissures or cavities which lower the specific gravity. The differences in specific gravity of the various oxides are not sufficient to account for the lowering. Bolton and Weigand also approached this analysis from another angle, showing that in some instances the fissures are mere continuations of localized shrinkage cavities or drawholes. Their conclusion is that the fissures are essen-

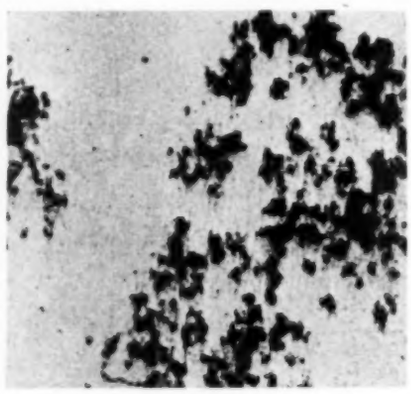


Fig. 7—Alumina Inclusions in Oxidized Copper Treated With Aluminum According to Comstock. Unetched, 200 Diameters

tially a shrinkage phenomenon, general rather than localized, and microscopic rather than macroscopic. This type of general microscopic network fissures they have named *incipient shrinkage*. Their evidences are summarized as follows (*Transactions*, A.I.M.E., 1929):

"1. An ordinary foundry shrinkage cavity is characterized by varying amounts of more or less perfect dendritic skeletons. Just around the cavity is a spongy area. This may not be visible to the naked eye on either a machined or fractured surface but is quite evident after deep etching. Farther away from the shrinkage cavity are areas that appear visually sound even on deep etching. If these visually sound areas are etched and examined under the microscope, a porous structure may be found. As the distance from the cavity is increased, the metal becomes sounder.

"2. Porosity is most common in sections of improper design, for example, where heavy sections run into light. The long temperature interval between primary and final crystallization, the apparently high viscosity

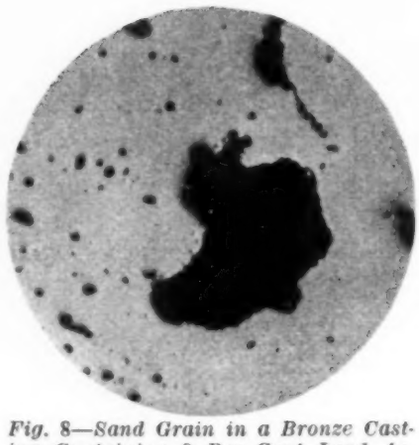


Fig. 8—Sand Grain in a Bronze Casting Containing 9 Per Cent Lead According to Comstock. Unetched, 50 diameters

of these liquids, and the differences in cooling rates between light and heavy sections, all promote feeding of the light section at the expense of the adjacent heavy section and consequently cause foundry shrinkage. When tested, such shrinkages often exhibit the regular darkened fracture called oxidation.

"3. The most porous sections occur in the center of the section rather than near the skin, thus the factors influencing porosity come into play near the latter end of the solidification period. This is characteristic of ordinary foundry shrinkage. Also that is a reason that highly machined castings are more difficult to make sound than are castings with the skin on.

"4. Chilled castings rarely shrink or show porosity. The rapid cooling cuts down the time interval, thus minimizing temperature gradients. There is less time for selective solidification and segregation; also for the freeing of dissolved gasses.

"5. It is well known that proper pouring temperatures help to minimize porosity. It is easy to show that castings poured at too low a temperature cannot *feed* properly, and as a result often are unsound (a shrinkage effect). Furthermore, when poured at too high a temperature there may be actual ejection of

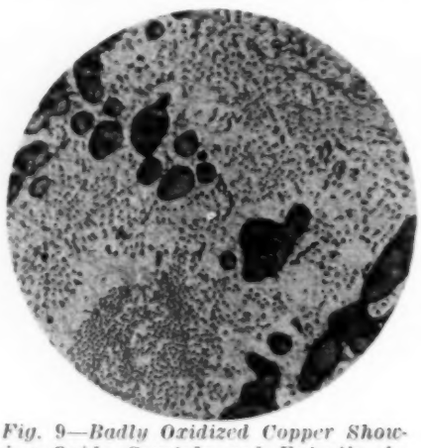


Fig. 9—Badly Oxidized Copper Showing Oxide Crystals and Eutectic According to Comstock. Unetched, 200 diameters

metal (causing cauliflower head) with consequent unsoundness beneath. This is probably due to gas rejection as well as to external contraction. The effects of pouring temperature on strength are quite marked when metal is melted under reducing atmospheres. As in other metals, the pouring temperature affects the crystallization characteristics.

"6. Proper gating helps to minimize porosity. The only way it can do this is by helping to counteract the tendency toward foundry shrinkage. Porous castings, which show the characteristic darkened fracture termed oxidation, often can be made reasonably sound by proper gating.

"7. Dissolved gases play a part in causing porosity. At first glance their effect may not seem related to shrinkage. During crystallization the mother liquor becomes more and more saturated with gases. At the moment of solidification their solubility is greatly diminished. Suppose that the

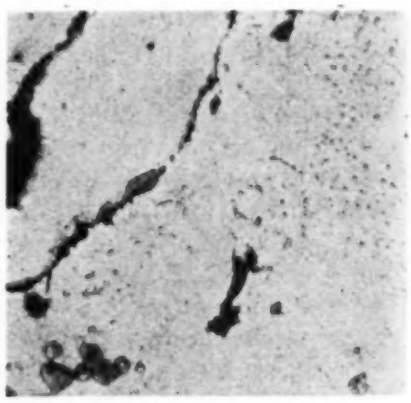


Fig. 10—Silicate Inclusions and Streaks According to Comstock. Unetched, 200 Diameters

saturation is excessive for solid metal, and that gases are rejected in the crystal interstices. This prevents feed back of the metal—causes shrinkage by preventing feed through back pressure rather than by pulling away metal, as a thin metal section would. In either case the effect is the same—insufficient liquid metal, hence shrinkage. Using another illustration—when the metal is just saturated with gases, contraction (pull) sets in in the plastic material. Pressure is lowered—there is a force for evacuation—then some of the gas is freed more readily. This allows the contraction to pull the plastic crystals apart more easily."

Bolton and Weigand also state that the coloration of fracture associated with *oxidation* is an incidental phenomenon. Porous metal may appear *clear* on a fresh fracture, the water or gases seeping in during test or manufacture discolors the exposed facets. However, quite porous metal undoubtedly may show the coloration when broken immediately after casting. That is a *clear* fracture does not necessarily indicate absolutely sound metal, whereas a bad fracture unquestionably means bad metal.

The viewpoint that the networks are intercrystalline fissures, not films, seems to be becoming generally accepted by American metallurgists today as is the term *incipient shrinkage.* Therefore this term will be employed to indicate the type of porosity previously characterized and heretofore generally called *oxidation* by foundrymen.

While there may be general agreement as to the general nature of incipient shrinkage phenomena, full unanimity of opinion as to the causes has not yet been reached. It generally is admitted that actual oxidation of the metal, if severe increases the tendency toward incipient shrinkage. Contamination by aluminum produces coarsely crystalline metal and marked porosity. Silicon also is known to affect some bronzes adversely. Insufficient gating and too low pouring temperatures often cause incipient shrinkage. However, for many years foundrymen have noted that in absence of impurities, and melting under reducing atmospheres, incipient shrinkage may occur, often in aggravated form, and it could not be eliminated completely by gating or by regulation of pouring temperatures. The metal appeared to be gassed.

Reducing Atmospheres Detrimental

Slow melting or excessive pouring temperatures made conditions worse. The metal often boiled in the ladles and in some cases the gates and risers showed *cauliflower head.* As a result of these observations a number of workers have investigated the effects of reducing atmospheres. Their evidence indicates that reducing atmospheres have an extremely deleterious effect on the metal and may produce incipient shrinkage in some bronze alloys. Consequently, many metallurgists believe that in addition to other causes, reducing atmospheres are detrimental to production of sound bronzes.

Before discussing the various causes of incipient shrinkage consideration will be given to the operating characteristics of several commercial furnaces, to the reactions of gases on copper, and to the structural characteristics of the alloys under consideration. In theory the sealed crucible is an ideal melting unit for production of high quality bronze. The metal is held in a closed container. It is not exposed directly to the action of the furnace gases, and the likelihood of pickup of impurities from the crucible itself seems slight.

Theoretically what is put in should come out. In practice there is some volatilization, particularly of zinc. It takes time to get the metal hot, and if the cover is removed to get more rapid heat absorption, there is direct exposure to the furnace atmosphere. Oil and gas-fired open flame furnaces have been popular for some time. Properly regulated they are fast economical melters. Metal loss may be kept down to a fairly low point by proper burner regulation and by slag covering. In these furnaces the metal is exposed directly to the action of the fuel-air mixture and to the products of combustion.

In the combustion the oil or gas is burned by air—both fuel and air being admitted through a burner. Oils are mostly liquid hydrocarbons, compounds of carbon and hydrogen with small percentages of nitrogen, oxygen and sulphur. Natural gas is mainly methane (CH_4) and some ethane (C_2H_6). The combustible materials in artificial gases consist largely of carbon monoxide (CO) methane (CH_4) and hydrogen (H_2). These gases also contain some noncombustible carbon dioxide (CO_2) and considerable nitrogen (N_2).

Shows Gas Reactions

Typical combustion reactions of the various gases are:

$CH_4 + 4O = CO_2 + 2H_2O$ plus heat

$2CO + O_2 = 2CO_2$ plus heat

$2H_2 + O_2 = 2H_2O$ (water) plus heat

Carbon monoxide, methane, and hydrogen which unite with oxygen commonly are called reducing gases. Oxygen, of course, is an oxidizing gas. Carbon dioxide, water vapor, and nitrogen usually are considered neutral gases by the combustion engineer. Thus, a neutral atmosphere is one which consists entirely of neutral gases. A reducing atmosphere consists of reducing gases plus neutral gasses. An example is 6 per cent carbon monoxide, 11 per cent carbon dioxide and 83 per cent nitrogen.

(*Concluded on Page* 109)

Describes Appearance

GENERAL porosity or unsoundness in bronzes and red brasses as distinguished from localized areas has been attributed usually to oxidized metal. However, careful observation has shown that condition to exist when metal has been melted in neutral and reducing atmospheres. To supply a distinctive term for the condition to be discussed, incipient shrinkage has been chosen. This first of several articles on the subject describes the appearance of the fracture of the defective metal and discusses some phases of combustion in melting. The next article will be published in an early issue. Eight of the micrographs reproduced in this article were supplied through the courtesy of G. F. Comstock, Niagara Falls, N. Y., and are used with the permission of the American Institute of Mining and Metallurgical Engineers.

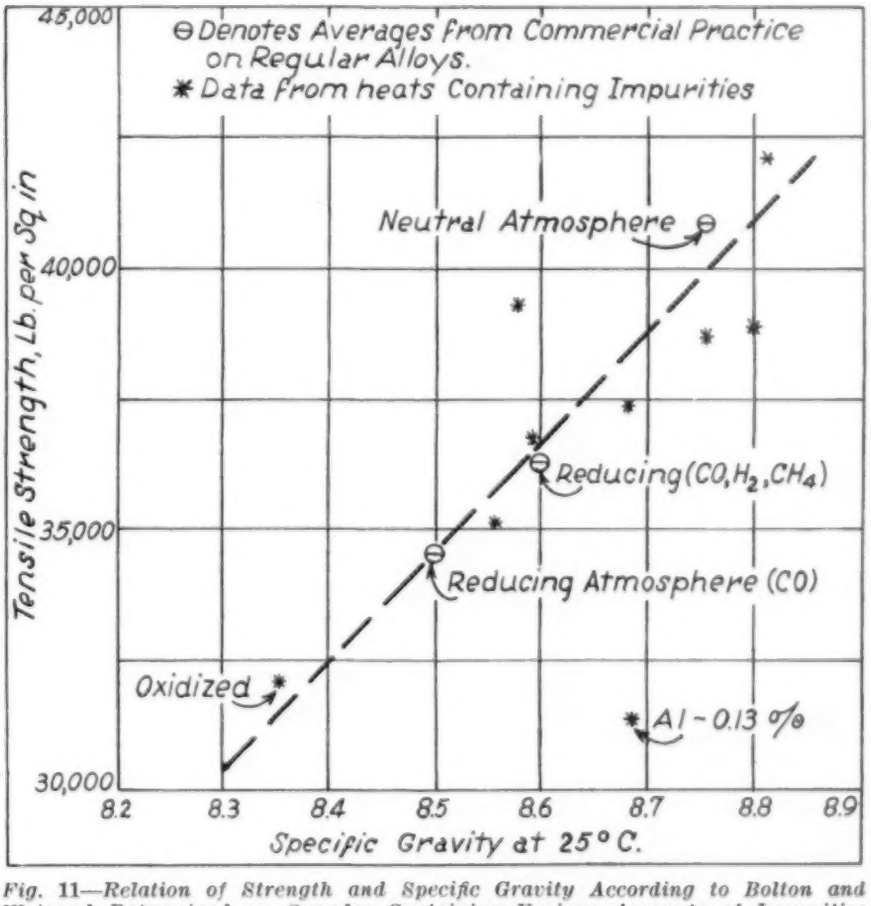


Fig. 11—*Relation of Strength and Specific Gravity According to Bolton and Weigand Determined on Samples Containing Various Amounts of Impurities Made in Commercial Practice*

Melts Gray Iron for Stove Plate in the Electric Furnace

Increased Production, Lower Iron Cost at Spout and Flexibility Are Important Advantages of Continuous Melting

BY N L. TURNER

A POINT was reached at the Beach Foundry, Ltd., Ottawa, Can., 21 months ago when it would have been necessary to extend the floor space materially to cope with production necessary for increasing business, if noncontinuous cupola operation was used. As additions were undesirable, a system had to be evolved whereby a greater volume of castings could be obtained from the same amount of production space.

As a melt of from 20 to 30 tons was not considered a high enough tonnage to merit continuous cupola operation, a more adequate means had to be devised. After due consideration it was decided that an electric furnace as a melting unit would be the most feasible way to accomplish the desired results. Therefore a 3-ton furnace was purchased.

Increases Production

The main objective has been successfully reached through continuous operation, as the same floor space and molding equipment can be used a number of times during the day. This considerably increased the production per floor and, at the same time, materially decreased the cost of molding equipment necessary. Since that installation was one of the first of its type producing stove plate castings, a considerable amount of research was necessary to determine the analysis of iron most suitable. This involved the determination of a standard charge with the raw materials available. It also was necessary to ascertain the best pouring practice to be followed in the shop.

Through improvements made in practice, the electric furnace has proved to be an ideal melting unit on this class of castings. There are at least three distinct advantages which have been gained by continuous operation. These are as follows:

(1) Production of castings has been increased 25 to 30 per cent under existing conditions.

(2) The cost of iron at the spout is considerably less than previously obtained.

(3) The flexibility of the method has proved valuable in speeding up production and coping with rush orders.

Superiority of the electric furnace as a melting unit is displayed in its capacity for handling charges that could only be melted in the cupola with heavy losses. It is now the practice at the Beach Foundry, Ltd., to melt approximately 40 per cent of cast-iron borings, which has been found to be an economical and low-loss raw material. Cast-iron borings in the district can be purchased at a much lower price than other scrap metal, and, with the necessary additions of ferrosilicon, ferrophosphorus and ferromanganese, can be converted into a high grade gray iron at a much lower cost than previously could be obtained.

The disposal of steel clippings from the sheet-steel department formerly caused considerable trouble. Expense of baling and shipping rendered them valueless, and the company was forced to dispose of them by dumping them on the scrap heap. With the installation of the electric furnace, steel clippings are treated as a raw material, making them part of the first charge. However, it is inadvisable to melt them in large quantities, because of the tendency to reduce the carbon content.

Since the electric furnace was installed, no pig iron has been used in the charges, and at the same time a better quality of gray iron has been produced than that formerly obtained in the cupola. One of the deciding cost factors is the power. In districts where power can be obtained at a reasonable rate, the cost of iron at the spout would be lower than that of the cupola. However, at equal cost, a considerable saving is effected through outside conditions. It may be added that kilowatt-hour consumption per ton is higher under continuous operation than batch melting. The cost summary of Table I shows some interesting details.

Explains High Return

It will be noted that the percentage of foundry returns is high in comparison to the total melt. This is due to the nature of the work, which is light stove plate. A large percentage is made on machines from matchplate patterns, where the sprues and gates almost equal the weight of the casting. Attention also will be drawn to the fact that the cost of power per ton is high in comparison to the favorable rate that the company has. This is due to operating the furnace under its capacity with a low load factor of 37.05 per cent.

A 3-ton furnace gives the best efficiency when operated at 2000 horsepower and at least 65 to 70 per cent load factor. That would decrease the cost of power 50 to 60 per cent. The company contracts for its power at 11,000 volts on a flat-rate basis of $23.00 less 10 per cent and 5 per cent per horsepower per year (net $19.67). While operating under capacity, the firm has a composite rate as follows: Service charge, 0.8 cent per horsepower per month; first 50 kilowatts used in month, 1.3 cents per kilowatt per month; second 50 kilowatts used in month, 0.9 cent per kilowatt per month; balance of kilowatts used

Increases Production

NEARLY two years ago, a demand for increased production without increase in floor space led the Beach Foundry Co. to install an electric furnace for melting gray iron to be poured in stove plate castings. Results obtained from this installation and the advantages of operation are set forth in this article, which is abstracted from a paper presented at the Cleveland convention of the American Foundrymen's association. The author is metallurgist, Beach Foundry Ltd., Ottawa, Ont.

in month, 0.12 cent per kilowatt per month.

The low cost per ton shown on the cost statement is due to the low-priced raw materials available in the locality. One of the main factors contributing to the greatly reduced cost is the lack of pig iron in the charges. As No. 1 pig iron at present is $25.00 per ton, f.o.b. Ottawa, that can be recognized readily as an important cost item.

Explains Melting Practice

To maintain the continuity of operation, an initial bath of iron must be built up before the continuous charging and tapping may take place. After the last iron is tapped out, the pits are cleaned, the furnace bottom patched, and the first charge consisting of gangway pig, foundry returns, stove-plate scrap, cast-iron borings and steel clippings, is charged into the furnace. At a fixed time, the melters come on duty and commence to melt down the first 3-ton charge. On completion of this operation and when the iron is up to temperature, the furnace is slagged off and more borings are added in suitably sized charges, until the bath contains nine tons.

On completion of the melt-down of the original bath, a test bar is poured and a complete analysis is taken before any iron is tapped. This enables the metallurgist to correct any discrepancies in analysis, and to maintain a constant quality of iron. When the iron is passed by the chemist and is up to temperature as recorded by an optical pyrometer, the first ladleful is tapped. The first bull-ladle of iron usually is tapped out at 7:00 a.m., to pour off any molds that have been left from the day before or any overtime molding accomplished the previous evening. Sometimes it is necessary to tap out several bull-ladles in succession, to meet with shop requirements, but this serves to stress the advantage of the flexibility of the system in providing iron at any time. After a tapping, a feed charge is added. This operation of tapping and feeding is continued until the necessary amount of iron is obtained for the day's cast.

The feed charges consist of foundry returns and stove-plate scrap, which do not require the addition of any alloys. It is a good practice to mix a charge of foreign stove-plate scrap with foundry returns, because it is found that return scrap has a tendency to oxidize the iron and reduce the carbon content. About 1 per cent of ground coke is added with each feed charge to take care of any loss of carbon that may take place in the melting.

Feed charges under present requirements consist of approximately 1100 pounds of iron, which takes between 15 to 30 minutes to melt, depending upon the power input. About 1100 pounds of iron are tapped. However, this depends upon shop requirements. The minor operations, such as daubing the bull-ladle, repairing the spout and grinding the coke, are taken care of by the melter and his helper, who can attend to these in conjunction with the original melt-down. The bull-ladle is heated up in the morning by a gas blast before any iron is poured into it. This obviates chilling the iron by a *green* ladle.

The shop is divided up into pouring stations and the bull-ladle goes to each station according to schedule, or as desired. The stations are signaled by a whistle at the furnace, so that the molders and shaking-out crew designated to that station will be ready for iron. Careful temperature control is kept throughout the day. Every bull-ladle of iron has to pass the temperature test before it is conveyed to the pouring station. The ability to control the analysis produces a grade of iron which almost is unvarying in its consistency.

Gives Ideal Analysis

We have found the ideal stove-plate gray iron analysis, for iron melted in an electric furnace, to be within the following ranges: Carbon, 3.25 to 3.35 per cent; silicon, 2.75 to 2.85 per cent; phosphorus, 0.60 to 0.70 per cent; manganese, 0.45 to 0.60 per cent; sulphur, less than 0.09 per cent.

With electric-furnace stove-plate iron, it has been found necessary to keep the silicon higher than that of cupola iron, and it should never drop below the minimum outlined above. During the day, there is a slight increase in silicon, undoubtedly picked up from the slag and furnace bottom. This can be controlled by the addition of some low-silicon raw material, such as borings. During the experimental period, considerable difficulty in keeping up the carbon content was experienced, but this was overcome by the use of the proper amount of ground petroleum coke.

On continuous operation the refractories do not give so high a tonnage as on batch melting, but the following figures may be considered satisfactory: Roof about 650 tons and lining about 850 tons. Considerable difficulty was experienced at one time in maintaining the bottom, but through improved practice, a method of patching the bottom has been evolved which has proved satisfactory.

Table I

Electric Furnace Cost for One Month

Raw Materials:	Pounds	Cost per ton	Total cost	Total cost per ton
Stove plate	102,095	$12.50	$ 637.50	
Borings	234,450	10.00	1,172.50	
Steel scrap	27,455	.....	.....	
Foundry returns	323,285	13.00	2,100.80	
Additions	8,290	.....	.....	
Total	695,575		$3,910.80	$11.25
Additions:	**Pounds**	**Cost per lb.**	**Total cost**	
Fe Si	6,350	$ .03	$ 190.50	
Fe Mn	750	.04	30.00	
Fe Ph	1,190	.06	71.40	
Coke	13,200	.006	79.20	
Total	21,490		$ 371.10	1.07
Labor			$ 397.72	1.14
Power			1,825.55	5.25
Electrodes				2.09
Refractories				.60
Water				.11
Laboratory				.50
Interest on investment, and depreciation				.57
Melting loss				1.13
TOTAL COST OF OPERATIONS, PER TON				$23.71

Use Many Castings in Water Tunnel

American Manganese Bronze Co., Philadelphia, recently received the contract for ten, 48 x 36 x 36-inch, twenty-two 72 x 48 x 48 inch and one 48 x 36 inch bronze shaft caps and appurtenances for city tunnel No. 2 a section of the new water tunnel for the board of water supply, New York. Contract calls for 150 tons of manganese bronze castings and 5 tons of cast steel flanges.

The 72-inch caps will be among the largest manganese bronze castings ever poured, weighing 25,000 pounds before and 23,500 pounds after machining. The shaft caps will be used as heads on riser valves. Contract for part requirements recently was awarded to the American Locomotive Co., New York.

More than 2000 tons of manganese bronze castings will be used in the tunnel before completion. Bids were opened July 22 on a 5 x 10 x 4-foot sluice gate and operating mechanisms for the equipment.

Fundamentals of
FOUNDRY PRACTICE

Several Alternative Methods Are Presented for Sweeping Wheels and Pulleys with Various Types of Arms

By Ivan Lamoureux

(Interpreted in the Light of American Practice by Pat Dwyer)

Part XV

TO SWEEP the cope, the sweep arm is placed on the spindle and the sweep is attached solidly to it by screws or bolts, depending on whether it is wood or iron. Part of the sand which has served as a pattern is removed with the trowel to form the first rough outline. The face then is vented with a wire and the sweep is lowered until the outside end almost touches the joint on the drag. The mold is finished by following the ordinary methods used at the time of sweeping the pattern in sand. The face is sprayed with water and then covered with black wash, applied either with a brush or swab. In many modern foundries it is applied from a spray can actuated by compressed air.

Form Openings with Cores

If openings are required in the web, they are formed with dry sand cores, or by flat disk cores rammed in place. Their position is laid off with a pair of dividers or short trammels.

The central core print is formed by first removing the spindle and filling the hole up to within about 2 inches of the bottom of the hub. If the diameter of the core is the same as that of the spindle, the hole will serve as the print. If the diameter of the core is smaller than that of the spinde, it will be necessary to plug it and then bed in a core print of the required size. If the diameter of the core is larger than that of the spindle, a core print of the desired size with a hole 1½ inches diameter in the center is dropped down around the spindle and bedded in place. The mold then is ready to be put into the drying stove if made in a flask and to be dried on the spot if molded in the floor.

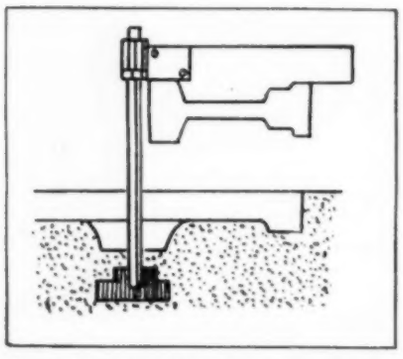


Fig. 177—Combined Cope and Drag Sweep

Sweeping Pulleys

ALTHOUGH the sweep method rarely is resorted to in American foundries on the size of castings selected by the author for examples, the basic principles and the mode of procedure are practically alike. Also it must be borne in mind that this course of instruction was prepared originally for use in a technical high school where the facilities for handling large castings were not available. Detailed description is presented for setting the sweeps and forming the molds for various types of wheels. Reference is made to the manner in which pulleys are molded by the sweep method in American foundries.

In molding a spoked fly-wheel with six spokes of elliptical cross-section the joint will pass through the axis of the spokes. After making a flat joint, two circles are traced to indicate the inside and outside of the rim. The outside circumference then is divided into six equal parts and radial lines are scratched on the joint with the aid of a straight edge containing a notch for the spindle.

The pattern for one-half of a spoke is placed on the joint with the center line coinciding with one of the radial lines and a mark is traced in the sand on each side. This is repeated for each of the six arms. When the last arm has been traced, the pattern is left in place and fastened with some nails. Facing sand is placed all over the joint, except where the arms are outlined. This precaution prevents placing gaggers at the place where the spokes will be imprinted later. The cope is set in place, gaggered, filled with sand and rammed as previously described. The gate pin may be placed on the hub or between two of the arms.

After the cope is removed a clearly imprinted outline of the spokes and of the circumferences will show on the face. The single half arm pattern then is bedded in the various places marked for its reception in the cope and drag. Great care is required to make the impression exactly according to the center lines.

Nails Serve as Guides

Before hollowing out the form for each arm, stick in four large nails in the sand to serve as guides. They are removed as soon as the pattern is bedded in. The remainder of the mold is patched and finished in the usual manner.

If the width of the rim face does not exceed 8 inches, the molding of a straight arm pulley does not differ at all from that of the flywheel. When the width exceeds 8 inches the procedure is slightly different, but only in the drag. Instead of shaping up the exact form of the rim in the drag after the cope is removed, only the outside face is swept to size. A generous space is cut away inside the rim to permit easy sweeping and a good chance to patch the outside face of the rim. A segment block *P*, Fig. 180, cut to the shape inside

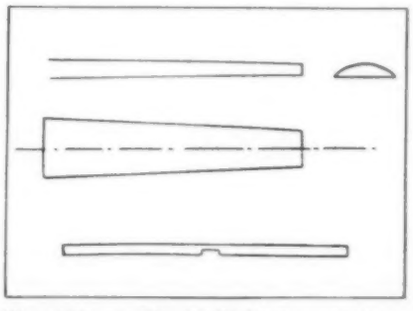


Fig. 178—A Single Half Arm Pattern Is Used

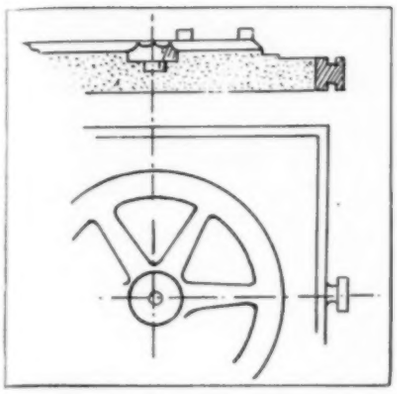


Fig. 179—*Method of Forming the Fillets at the Ends of the Arms*

and outside, is employed to form the inside of the rim. The outside of the segment rests against the face of the mold and sand is rammed in the space inside the segment pieces. The segment block is moved successively around until the circle is completed.

Where loam molding is practiced the outside of the mold is built up and swept independently on a lifting ring. This style of molding is employed mainly for flanged or grooved pulleys as shown in Figs. 181 and 182. The majority of pulleys can be poured in green sand as their thickness as a rule is not great.

In another method practiced to a considerable extent in American foundries the sand is not cut with a sweep but is rammed directly to the dimension required against a section of the pattern solidly attached to the sweep-arm. In this method no patching is required after the device has made a complete turn. It is obvious that a casting molded in green sand according to this method preserves all the porosity of the sand and prevents scabs.

To apply this method the molder levels off a perfectly level space on the floor or on a drag by a sweep. This surface is slicked and covered over entirely with parting sand.

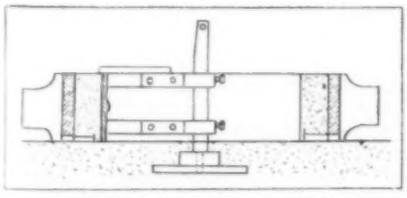


Fig. 183—*The Mold Is Formed With a Segment Fastened To a Sweep Arm*

Where a wood flask is used the inside is studded with nails near the lower joint to hold the sand. An iron flask is equipped with a sand strip or chuck bars for the same purpose.

The flask is placed concentric with the spindle and guide stakes are driven on the outside. The sweep is set up and consists of two sweep arms which support a curved board for producing the outside and inside surfaces of the rim as shown in Fig. 183. The outside is formed first. The spaces at the ends of the segment are closed temporarily with pieces of plank as shown in Fig. 184. A joint is made at the top and then the segment is rapped and moved a short distance to the right. This procedure is continued until the entire circle is formed. The cheek then is lifted and placed on supports where plumbago is applied to the face with a brush.

The arms and hub are made in halves in coreboxes. Each arm core consists of two halves held together with paste. The lower half of the hub core is placed at the proper height in the center and the sweep is employed to level off a flat surface at the proper height for setting the arm cores for the spokes. These are set at equal distances apart. They fit closely at the hub and require no measuring. At the outer ends their position is determined by a pair of trammels or a gage stick. The upper half of the hub core then is placed and the remainder of the inside of the mold is filled and rammed in the same manner as the outside. The sweep arm shown in Fig. 185 is employed to hold the segment while ramming the inside part of the mold.

When the inside is finished the face is brushed with blacking. The spindle is removed and the central core is put in place. Sometimes the upper half of the hub core is left off until this stage. Then it is dropped into place and the space above it is filled with sand. The cheek then is returned to place and the open rim is covered with a ring of flat cores. In many American foundries the rim is left open. A man armed with a light rod watches down the rim during the pouring period and prevents any foreign material from adhering to the walls of the mold while the iron is rising. The metal is poured in through one or two upright gates located on the hub of the casting.

The same method may be employed in molding a split pulley with the exception that suitable blocks for forming the bolt lugs and containing prints for the splitting cores are bedded in at two diametrically opposite sides of the rim and hub. After the mold is finished, splitting cores are placed in these prints. The cores do not project quite through the metal. A sufficient amount of metal is left to hold the wheel together as a unit until after it has been machined. If the mold was divided into two independent parts, the contraction of the metal would pull the half wheels *out of round.*

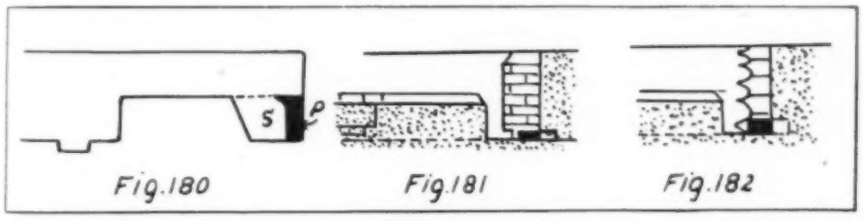


Fig. 180 *(Left)—The Loose Piece P Is Employed To Form the Inside of the Rim. Figs.* 181 *and* 182—*The Loam Cheek Is Lifted On a Ring*

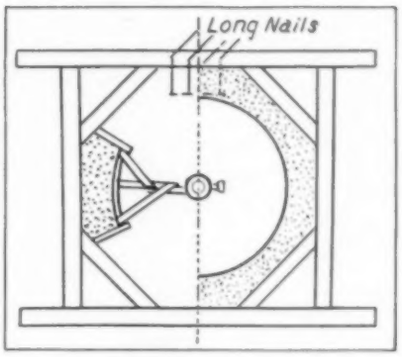


Fig. 184—*Method of Forming the Cheek Mold for a Pulley*

Dries the Molds

In some instances the inside part of the mold is dried and the outside is formed in green sand. In others the inside is formed in green sand and the cheek is dried and in still others, both inside and outside are dried. Modifications of the foregoing method may be adopted to meet any of these conditions.

Molding curved spokes require either a special templet of uniform thickness and two strickles or a templet of decreasing thickness and one strickle. The molding of such a pulley is characterized by the following points:

When the joint is swept and covered with parting sand, radial lines, corresponding to the number of arms, are drawn on the surface. The templet Fig. 186 is placed over each line in turn and the shape of the arm is traced in the sand. This templet is composed of two parts with a space between the shape of the spoke. The parts are connected by two small strips fastened by screws.

After the cope is removed the spokes are swept out by a strickle cut according to their cross-section.

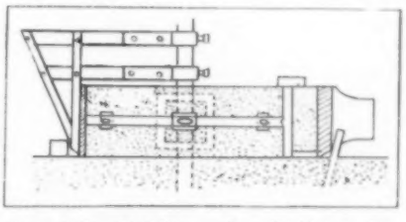


Fig. 185—*Holding the Pattern Segment While Ramming the Inside Part of the Pulley Mold*

bearing in mind the thickness of the templet.

To sweep out the half arms in the cope the templet is reversed. In working the cope, sometimes a gagger will be found sticking up through the sand. In such a case, the gagger is driven in with light blows from a hammer directed in the direction of the stem of the gagger. If the gagger is found near the edge of the joint, the wall is held with one hand while the gagger is driven back with the other. In pulleys less than 20 inches diameter, templets are not used. A pattern of each spoke half is imprinted in the cope and the drag.

Readers Comment

Has Different Theory

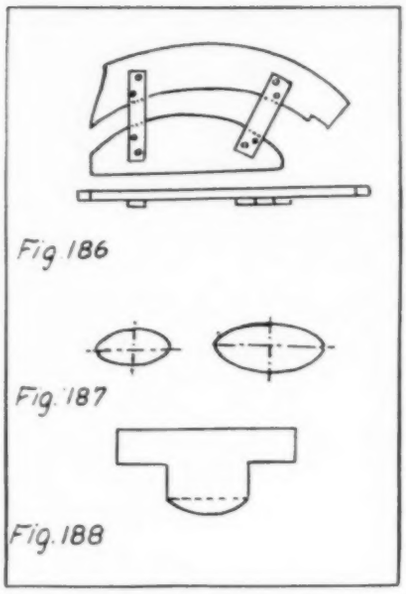
To the Editors:

May I take exception to your answer under the heading *Core Shifts Bend Posts* in the June 1 issue of The Foundry. So often "us foundrymen" say just the opposite of what we think. According to the published answer "The thin side (of the lamp post) cools first and pulls the casting crooked" and in another paragraph "the stripped side most assuredly will cool first and exert sufficient pressure to *raise* both ends from ⅛ to ½-inch above a straight line." (This has reference to stripping the cope too soon). In my opinion, just the opposite takes place. The heavy side of the post will draw the casting crooked and the center will rise instead of the ends. In other words, the heavier part of a long casting, cylinder, angle, channel or any other shape, will cool last and thereby draw the casting crooked. I believe the casting remains straight so long as it is red, but a time comes when the thin part becomes black while the heavy part still is at a red heat. From this point it would seem reasonable to assume that the red part of the casting shrinks more than the black or light part since it still has a greater range of temperature to pass through.

W. H.

Editors' Note:

We are glad to see you have the true inquiring mind, also the courage of your convictions to point out what you consider an error. For the same reason we know you are willing to accept proofs when they are offered, even though they are contrary to your former belief. Your theory is plausible so far as it goes, but it does not take a certain practical feature into account. If a casting was formed of an elastic material, free to move in any direction during the entire period of cooling, your theory would apply. Unfortunately, an iron casting is subject to rigid limitations. Cooling metal



Figs. 186, 187 *and* 188—*Templet, Arm Sections and Strike, respectively for Forming the Arms in a Pulley Mold*

contracts—but—only if in condition to contract. Thus when the top or thin side of the post under discussion, cooled first, it reached its limit of contraction before the bottom or hot side started to contract. With the top side short and the bottom side long, the inevitable result was a slight bow in the entire casting. The ends were higher than the center. You admit that the ends rise in the early stage, but you claim that the later cooling of the bottom will not only pull them back, but actually will draw them below a straight line. That would happen if metal contracted uniformly under all conditions. In the instance under discussion, the top cools first and becomes rigid. The bottom cools later, but the rigid top prevents it from contracting as it should. The result is that the casting remains bent with the ends above a straight line and with the metal in the bottom in a state of tension. However, as the late president Cleveland said once upon a time, "It is a condition and not a theory which confronts us." All you have to do is to look at an open sand plate.

If it is left uncovered after it is cast, the top will cool first and the ends will rise. What is more to the point, they will stay in that shape. The same law governs columns and pipes cast horizontally, if the top cools first for any reason—the ends will be up.

Suggests More Study

To the Editors:

I have read with much interest the letter from Mr. F. A. Lorenz, Jr., of the American Steel Foundries, which appeared in a recent issue of The Foundry.

I quite agree with him and having taken the foundry courses at the University of Illinois and Armour Institute of Technology, I believe that there is much room for improvement in the teaching of the latest methods of foundry practice. This of course would make the graduates more valuable to the foundry industry and would naturally reflect in the standing of any particular college.

Permit the suggestion that you publish an article to be written by any college instructor, who is familiar and has had experience in actual foundry practice, using as a possible subject "Making Better Foundrymen in the American College." I believe that such an article would be of great interest to all foundry executives and instructors of foundry practice in our colleges.

B. V. Nutt

Moline Iron Works,
Moline, Ill.

Sprays Pattern

To the Editors:

In the June 1 issue you had an inquiry entitled "Sand Sticks to Pattern" which refers to hot sand sticking to cold patterns as a condition on a conveyor. We have gone through that stage and find that the temperature of the sand does not make any difference with the mixture we are using for spraying the patterns. We started the mixture with 4 parts of kerosene and 1 part of lard oil, and we find it works perfectly.

As a matter of economy we have cut this down to 4 gallons of kerosene and 1 quart of lard oil and are getting good results. However, it is advisable to start with the first mentioned mixture. Use a spray can for applying and do not blow the oil off nor brush it off. Any oil in the pattern pockets will not hurt. One spraying will carry a large manifold pattern from 35 to 50 molds. Be sure and do not use parting of any kind while using the spray.

T. Ben Bennett

Vassar, Mich.

Moisture Is High

To the Editors:

In the upper right hand column on page 139, June 1 issue, it is stated, "The latter two mixes were used with approximately 4 per cent moisture."

The statement made at that meeting was that 4 per cent water was added at the muller to these mixes, resulting in about 2½ per cent moisture in the mold at the time of pouring under average foundry conditions of time and exposure.

While the difference does not appear to be important, steel foundrymen will recognize that 4 per cent moisture is too high.

Paul Bechtner

American Colloid Co.,
Chicago.

Shows Penetration *of Steel Cast Against Sand*

By P. L. Goodale

THIS article is presented to draw attention to the importance of the surface oxide, when steel is cast in sand molds. It is self-evident that the burning of liquid steel occurs on its surface, when it is in contact with the atmosphere. Since the sand mold for a casting is permeable, atmospheric pressure supplies the requisite oxygen for combustion of some of the steel cast in it.

When molten steel is poured into a mold constructed so that a surface of the liquid metal is exposed to the air, certain phenomena aways manifest themselves. The incandescent iron burns at the surface exposed to the air, combining chemically with the oxygen, forming iron oxide.

Experiments with Special Cores

The cross-section of the upper part of a steel ingot is shown in Fig. 1. Oxides are designated as *A* and *B*. *A* is the first oxide formed. It has a different coefficient of expansion than that of the steel beneath, and therefore flakes off, again leaving the steel surface exposed to the air. The surface now is cooled to about cherry redness but still is hot enough to burn slightly to form oxide *B* which adheres tenaciously.

The oxide *A* was found to be a mixture of ferrous and ferric oxides, analyses of which gave results of which the following are typical:

Fe_2O_3, per cent	34.60
FeO, per cent	62.31
MnO, per cent	.92

The oxide *B* was found to be pure FeO.

A series of experiments was made to demonstrate surface burning, by making a porous core, using sifted sand free from fines, and mixing with it five percent sodium silicate as a binder. This fastens each sand grain by glassy adhesion, after the core has been baked.

This experimental core, 4 x 4 x 2 inches, was placed in a large mold. After the steel had been cast against it, the metal was found to have an oxide attached, having a thickness of ¼-inch, which had to be pried off the casting. This may be explained by the fact that, due to its permeability, the core absorbed the oxide, capillarily, as fast as formed, thus cleaning the surface of the metal adjacent to it, so that it was free to burn (act chemically) with all the oxygen it needed until the metal cooled to a temperature where such action ceased. This is shown at *A* in Fig. 2.

Another core of the same dimensions as the first was made from zirconium silicate bonded with a small amount of sodium fluoride, producing after ignition at red heat a core that was practically air tight. The core was placed in the mold in the same position as was the original core. The oxide formed on its surface was noticeable only as a few small, black spots.

The experimental cores were white in color, and the depth of iron oxide penetration, which is dark brown to black in color, therefore was observed easily in both instances. Core *B* bonded with zirconium silicate is illustrated in Fig. 2.

Ferrous oxide melts at 2588 degrees Fahr. Inasmuch as the molten steel had a temperature of 2970 degrees Fahr., it is evident that the temperature above 2588 degrees caused the ferrous oxide to be extremely fluid, thus accounting for its filtration through silica washes, and for its absorption by a porous core-sand mixture.

A secondary chemical action often takes place between the iron oxide and the silica, depending, of course, on temperatures involved. Sand and iron oxide are substances that are chemically opposite in nature. These tendencies are accentuated by the molten steel in close contact. The reactions involved may be understood by referring to sketches 1, 2, 3 and 4 in Fig. 3.

Sketch 1, at the left of Fig 3, represents steel just cast against a core surface. There is an expansion of air in the core, and the flow of air is away and out. The molten steel is illustrated as a heavy, solid line.

Explains Penetration

Sketch 2 of Fig. 3 illustrates the condition a few seconds later than that shown in sketch 1. The casting surface begins to burn, forming iron oxide. This oxide, as previously stated, melts at 2588 degrees Fahr. and is extremely fluid at the temperature of the metal as cast, which is slightly less than 3000 degrees Fahr. The oxide is illustrated by diagonal lines.

Sketch 3, Fig. 3, shows the condition a few seconds later than that illustrated in sketch 2. The iron oxide reacts chemically with what are now hot sand grains to form iron silicate, illustrated by crossed diagonal lines. Its melting point is about 1200 degrees Fahr., much lower than that of iron oxide, with which it is mixed.

The sand grains at the surface often are eaten off flat, as can be seen under a microscope having ten magnifications. A flow of the iron oxide-silicate mixture into the core also is illustrated.

Sketch 4 of Fig. 3 shows the final core surface, where most of the iron silicate—mixed with ferrous and ferric oxides of iron—is drawn by capillary attraction into the core, in extent depending upon its porous condition. Points of contacts show evacuating spaces between these points, all visible under a low-power magnifying glass. Sand from surfaces of steel castings often may contain as much as 25 per cent, by weight, of absorbed oxides.

Studies Oxides

RESULTS of an investigation of the action of molten steel in the sand mold are given in this article, which is an abstract of a paper presented at the 1930 convention of the American Foundrymen's association, held in Cleveland. The author, Paul L. Goodale, is chemist for the Commonwealth division, General Steel Castings Co., Granite City, Ill. Attention is called to the importance of the characteristics and properties of core surfaces when steel is cast against them. The incandescent metal of the surface of the casting burns in contact with the air, forming an oxide slag which, being fluid at pouring temperatures, readily penetrates in between the sand grains of an open core and forms some iron silicate by action with the sand. In dry sand cores some of the oxide is reduced back to iron, forming a magnetic mass of material.

It is interesting to find that specimens of core surfaces that peel away from the castings often are magnetic. This does not happen in green sand, but is a common occurrence with baked core sand. As the oxides and the silicates penetrate more deeply into the core, they encounter carbon formed by the destructive action of heat upon the bonding materials used in making the core. This carbon has a reducing action, similar to that in the blast furnace, where oxides are chemically reduced to metallic iron.

Deposits Metallic Iron

In the case of dried cores, iron oxides flow into the interstitial spaces between the sand grains and there deposit metallic iron, which is sometimes found as a net-work of the shapes corresponding to the interstices into which it ran. These can be seen microscopically when the mass of a magnetic core is gently crushed and these little iron anchors are separated by a magnet.

When the interstitial net-work of metallic iron coalesces, scabs are formed and often are quite large and as far back into the core as ½-inch. To the eye they appear as fused metal with sand adhesions.

Should the magnetic surface of a core be broken into three parts, one of which is digested overnight in a warm place in an alcoholic solution of hydrofluoric acid (1:3) and then washed free from acid, the silica will be dissolved, leaving the metallic iron interstitial net-work. A microscope will reveal rounded holes, where the sand grains were originally. The mass is exceedingly magnetic.

When one of the other parts is extracted with warm hydrochloric acid to dissolve the metallic iron, interstices may be seen where the metallic iron penetrated it. The mass consists of sand and is non-magnetic.

The third or remaining part represents a conglomeration of the two materials described. This third substance is magnetic because of its iron content.

These data were assembled in attacking the problem that confronts those who cast steel against sand. It had been thought that the sand used was not refractory enough, and much time and effort were spent to obtain more refractory mixtures.

Oxide formation and action should not be overlooked in attemtps to solve such problems. Spraying of metal to close core surfaces, exclusion of air, displacement of air with inert gases, and oxidizing agents incorporated in sand mixtures (because higher oxides adhere less tenaciously than does ferrous oxide), are some of the expedients which suggests themselves to the author as meriting investigation.

Book Review

Die Casting Practice, by Marc Stern, cloth, 270 pages, 5½ x 8 inches, published by McGraw-Hill Book Co. Inc., New York, and supplied by THE FOUNDRY, Cleveland, for $2.65 and in London by the Penton Publishing Co. Ltd., 416-17 Caxton House, Westminster, for 12s 10d. postage extra.

It has been some time since any book has been published on die casting, and this volume brings the knowledge on the subject up to date and fills a long felt need. The author who has had extensive experience in the field of die casting covers this subject in a comprehensive manner. The book is divided into ten chapters which deal with the application of die castings, their accuracy and porosity; design of castings and dies; die construction and steels. Other topics covered are alloys for die casting; casting, cleaning and inspection of die castings; die casting machines; finishes for die casting, and alloying practice and control.

A. F. A. Directors Meet

New officers and directors of the American Foundrymen's association took office for the ensuing year at the meeting of the board held in Detroit, July 15 and 16. N. K. B. Patch, Lumen Bearing Co., Buffalo is the new president and E. H. Ballard, General Electric Co., Lynn, Mass., is vice president. The directors who took up service at this time include the retiring president, Fred Erb, Erb-Joyce Foundry Co., Detroit; H. R. Culling, Carondelet Foundry Co., St. Louis; C. S. Anderson, Belle City Malleable Iron Co., Racine, Wis.; R. M. Maull, Tabor Mfg. Co., Philadelphia; and D. M. Scott, Gould Coupler Co., Depew, N. Y.

L. W. Olson, Ohio Brass Co., Mansfield, O., who has served the association for the past ten years as director, vice president, president and again as director presented his resignation. The vacancy was filled by the election of Fred Wolf of the same company, who has been active in committee work and other affairs of the association for many years.

The place and date of the 1931 convention of the society was refered to the newly elected executive committee which consists of the president, vice president, the executive secretary, C. E. Hoyt and directors Fred Erb, S. W. Utley, Harold S. Falk and B. H. Johnson.

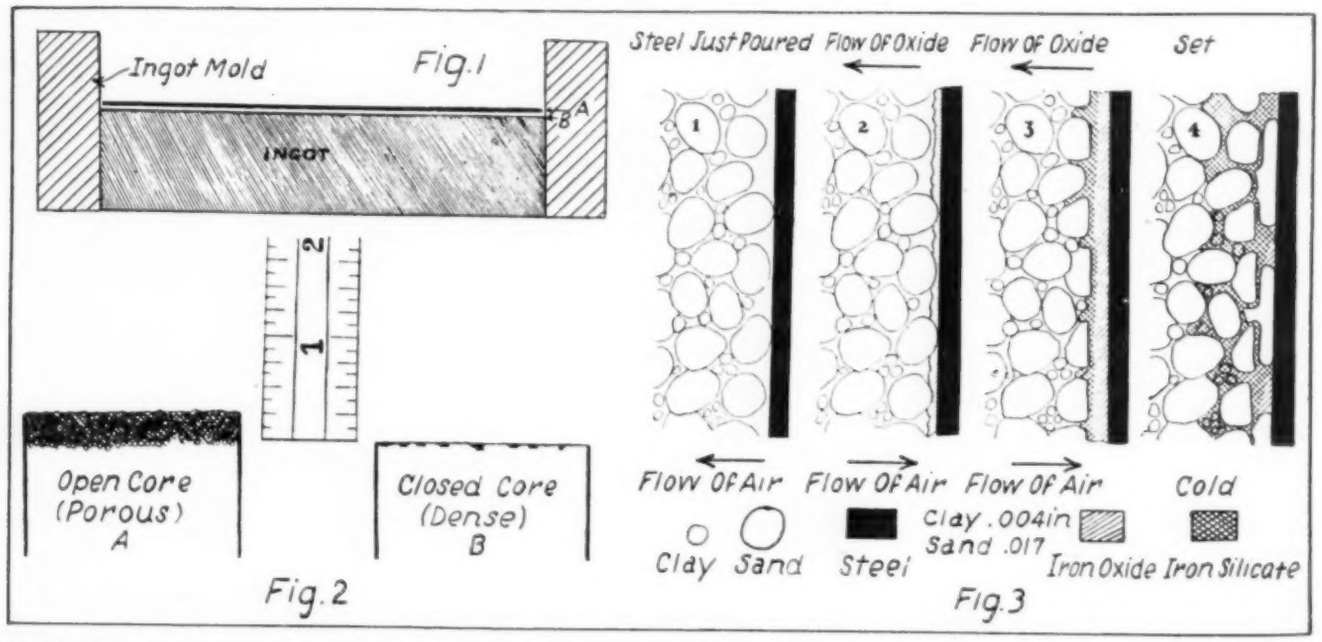


Fig. 1—The Oxide Surface, A, of the Steel Ingot Shown Is a Mixture of Ferrous and Ferric Oxides; the Surface, B, Is FeO. Fig. 2—The Oxide Penetration of the Open Porous Core Is the Greater. Fig. 3—Oxide Penetrates Cores in Various Stages

European Foundrymen Gather at Belgian Convention

Technical Problems Relating to the Foundry Industry Feature Program of Belgian Association

By Vincent Delport
European Manager, THE FOUNDRY

TWENTY-EIGHT nations were represented and over 1500 delegates of scientific and technical associations from every part of the world were present at Liege, Belgium, for the Sixth international Congress of Mines, Metallurgy and Applied Geology, which was held in conjunction with the centenary of the independence of Belgium from June 22 to 28. The third foundry convention of Liege, organized by the Association Technique de Founderie de Belgique was held in connection with the congress. The opening session took place in the amphitheatre of the Academy of Liege, under the presidency of P. Foumarier, professor at the university and a member of the Royal Academy of Science of Belgium.

At the opening session of the general congress on Monday, June 23, Carlo Vanzetti, president of the international committee of foundry associations, gave an address of welcome in the name of the various foundry associations.

Program Is Full

The first technical session of the foundry convention was held on Tuesday morning. Other sessions took place on Wednesday morning and all day on Thursday. The banquet of the Congress of Mines, Metallurgy and Applied Geology was held Wednesday evening with 700 guests present. The banquet of the foundry convention was the following evening at which 250 guests were present. Works visits were arranged during the congress at the Cockerill works at Seraing, where one of the finest heavy foundries of Europe could be seen, the Societe Metallurgique Ougree-Marihaye, Usines a Tubes de la Meuse, and the laboratories of Fabrique Nationale d'Armes de Guerre at Herstal.

The following countries were represented at the foundry convention, either by official delegates or by the presentation of an exchange paper: Belgium, Czecho-Slovakia, France, Germany, Great Britain, Holland, Italy, Luxemburg, Poland, Spain, Switzerland and the United States.

The opening session of the foundry convention was presided over by J. Leonard, of Societe Angleur-Athus, president of the Association Technique de Founderie de Belgique.

Twenty-eight papers were presented, which were divided into four groups: Methods of testing cast iron, special cast irons, malleable cast iron, sands and sundry subjects. The papers of the first group were discussed together, the subjects being: "Contribution to the Study of Testing Methods for Cast Iron," by H. Thyssen, professor of metallurgy at the University of Liege and president of the scientific committee of the Belgian foundry association; "The Application of the Shearing Test to the Control of Iron Castings," a report by the scientific committee of the Belgian association; "A New Machine for Bending Tests, Shearing and Hardness Tests on Test Pieces Taken from Iron Castings," by H. Thyssen and J. Bourdouxhe, of the laboratories of Compagnie Generale des Conduites d'Eau, Liege; "The Shearing Test by Punching; Its Application to the Control of Thin Castings," by A. Deleuse, of Fabrique Nationale d'Armes de Guerre, Herstal; "Considerations Based on the Results of Various Tests, Particularly Some Tests Effected in Czecho-Slovakia," by Prof. Dr. Ing. Mont. Fr. Pisek, rector of the polytechnic school of Brno, the latter being the exchange paper of the Czech association of foundrymen.

Discuss Test Bars

Discussion was opened by M. Girardet, foundry proprietor at Saint Die, Vosges, France, who, referring to M. Thyssen's mention of conical test bars, said that the author had arrived at conclusions similar to those which the speaker had reached and developed in the paper he had presented at the Cleveland convention of the American Foundrymen's association. To obtain a good shearing test it is necessary to have a clear-cut shear, and the machine must be adjusted perfectly. What is needed is a simple, economical test that can be used by as many founders as possible. Conical test pieces are convenient, provided that the conicity is quite regular. Referring to diagrams shown in the report of the Belgian committee, the speaker said that they show that results depend less on the absolute contents of combined carbon and graphite than on the distribution and the size of the graphite particles. With regard to test pieces cast as an excrescence on the casting, results are comparable when the dimensions of the test piece are in proportion to the thickness of the casting.

A. le Thomas, professor at the High School of Foundry, Paris, pointed out that when a casting is stressed, there are at first a number of fissures formed inside the piece, the positions of which depend upon the distribution and size of the graphite, and that the shearing line can never be straight. He deprecated the attempts made to find formulas giving an absolute relation between the results of various testing methods, and said that each test should be taken on its merits. Referring to the conical bar, he said its drawback is that only one test can be effected on each bar.

Results Vary with Speed

Professor A. Portevin pointed out that some results of testing have been found to vary with the speed of the testing operaton.

J. Variet, foundry manager at Societe Esperance Longdoz, referred to the new testing machine described by M. Thyssen and said this was, in his opinion, a really satisfactory machine, and especially good with regard to friction.

The exchange paper of the Institute of British Foundrymen was presented by the author, J. Deschamps, managing director of Kryn & Lahy, Ltd., Letchworth, England. The subject was "Considerations on the Respective Advantages and Drawbacks of the Various Methods Used in the Production of Steel in the Steel Foundry." Owing to shortage of time, it was decided that the discussion should be effected by correspondence. There also was a paper on "Electrolytic Iron," by Raoul Dupuis, of the Fonderia Milanese di Acciaio Vanzetti, Milano, Italy.

The Dutch exchange paper: "The Use of Fluorspar in the Cupola," was presented by D. Deurvorst, of N. V. Ijzergieterei en Emaillerfabriek Diepenbrook et Reigers, Ulft.

Dr. A. L. Norbury, senior metallurgist, British Cast Iron Research association, presented a paper on: "Factors. That Influence the Hardening Properties of Cast Iron." This paper was discussed with a contribution by R. Lemoine, professor at the High School of Foundry, Paris, on "High Duty Cast Irons; Recent Progress." J. Leonard said that identical castings made under identical conditions showed widely different aspects of the graphite particles. The cupola control is a considerable factor in this respect, as are special additions and the degree of oxidation of the iron. M. Girardet stated that the formation of the graphite particles in the cupola iron depends upon the state of the graphite in the original pig.

Discuss Chill Method

A. Le Thomas, referring to the method of testing the aptitude of cast iron to harden by casting a test piece in a chill, said that this method is unsatisfactory, because one cannot measure the speed of cooling. He mentioned the influence of heredity, and gave the example of a turbine casting for which some old scrap had been used. This casting was hard and brittle. Such a casting remelted and cooled under normal conditions retained this characteristic. The speaker said he believed that this is due to oxygen introduced in the form of dissolved ferrous oxide.

He experimented with two test pieces treated under identical conditions, but in one of which a little ferrous oxide was introduced, the aptitude to hardness in that case increased. Inversely, by deoxidizing, the aptitude to hardness decreased. In the cupola there always is some oxidation, but owing to the rapid passage of the burden through the cupola, this oxidation is limited. Another test, which confirmed the speaker's opinion, consisted in passing the molten iron through a column of charcoal. It may be asked why the oxygen reacts on the iron in the presence of silicon and manganese. This is due to the mass effect, and, furthermore, the temperature in normal foundry practice is not high enough for the ferrous oxide to be reduced by silicon and manganese. Superheating can be applied, provided that the slag is not oxidized.

The exchange paper of the German foundry association was presented by Dr. Ing. Geilenkirchen, director of the Verein Deutscher Eisengiessereien on "A Study of the Furnaces Used in Cast Iron Foundries." E. V. Ronceray agreed with the author that there is no reason why there should be a relation between the height and the diameter of a cupola. On the other hand, he said that the section of a cupola should be as simple as possible, provided that the cupola is well operated. Referring to the various types of furnaces, a type should be chosen for the particular object in view. M. Ronceray believes that the ideal furnace for that is the cupola, with a forehearth or, better still, with a ladle kept warm. An electric furnace can be combined with the cupola if necessary. The main points are to avoid complications and to learn to operate a cupola properly. In the course of the discussion it was stated that the rotary type furnace fired with powdered coal can be operated with scrap only, with a resulting economy.

M. Possenti, foundry proprietor at Pesaro, Italy, presented a paper on "The Desulphurisation of Cast Iron and Steel Through Aluminum—Potassium Silicate (leucite)." F. Renaud, foundry engineer, contributed a paper on "Nickel Cast Irons; Their Study and Recent Application." The exchange paper of the French association, by A. Le Thomas, was entitled: "A Few Physico-Chemical Modifications of So-Called Perlitic Cast Iron." An exchange paper also was presented by Spain, entitled: "Study of the Pressure and Volume of Air in Cupolas," by Jose' Canamersay Gonzalo, of Barcelona.

The last day of the foundry convention was devoted to malleable cast iron and sands. A paper by H. A. Schwartz on "Recent Developments in American Malleable Practice" was presented by R. Gailly, foundry proprietor at Charleville, France, who also contributed a paper entitled: "The Evolution of Malleable Foundries in France." Prof. Dr. Ing. Piwowarski, director of the Foundry institute of Aachen, Germany, dealt with the subject of "Modern Developments of Malleable Founding." The three papers were discussed together. Marcel Remy, foundry proprietor at Herstal, Belgium, said he regretted that Prof. Piwowarski deprecated white-heart malleable, which is made extensively in Belgium, while he agreed that the process of manufacture could be improved. White-heart malleable has its own peculiar qualities, and it is to be hoped that research work in that direction will continue. The speaker said he believed that white-heart malleable imposes itself in certain cases. He expressed the wish that a standard test piece should be adopted to arrive at comparable results.

Other papers were presented by: Dr. Ing. Rudolf Stotz, of Dusseldorf, on "The Applications of Heating by Pulverized Coal in German Malleable Iron Foundries "; M. Kagan and R. Deprez, engineers at Liege, on "Remarks on a Defect of Castings"; R. Deprez, "A Contribution to the History of Malleable Iron in the Liege District"; Andrea Bonaretti, Societe Isotta Fraschini, Italy, "Production and Applications of Light and Very Light Alloys in Italy"; F. Girardet, "The Simplified Practice of Metallography for Cast Iron."

Emphasize Sand Control

The first paper to be presented at the sand session was the exchange paper of the American Foundrymen's association: "The Control of Foundry Sands," by H. W. Dietert, U. S. Radiator Corp., Detroit, which was abstracted by V. Delport. M. Leonard, presiding at the session, emphasized the interest of the subject and commended the careful and effective methods described by the author of the paper. This was followed by a contribution by A. Deleuse, Fabrique Nationale d'Armes de Guerre, Herstal, on "Present-Day Methods of Tests and Control of Foundry Sands." A. Debar, professor at the High School of Foundry, Paris, presented a paper entitled: "Practical Data Concerning Drying," and the technical committee of the Belgian association presented a report on "The Casting of Fly-Wheels and Pulleys."

Lancastrians Hold Banquet at Liege Convention

ONE of the events that is looked forward to each year on the occassion of the principal foundry congress that is held in Europe, and sometimes in America, is the annual banquet of the Lancastria club. It will be recalled that this club, founded on the initiative of Frank Russell, of General Refractories, Ltd., Sheffield, is composed of the members of the European delegation who attended the international foundry congress in Detroit in 1926 and who sailed on the Cunard steamship LANCASTRIA.

This year's banquet, which was convened by Frank Russell, was held at the Antwerp exhibition, under the presidency of Paul Ropsy, and was claimed to be one of the most successful ever held by those who were present.

The setting of the banquet was remarkably well chosen, as it was held in a section of the Antwerp exhibition called La Vieille Belgique, which is a true-to-life reproduction

of Belgium in the middle ages, in an old-fashioned restaurant called Le Carillion d'Argent, meaning "The Silver Chimes."

After the banquet the guests took part in a dance which lasted until the early hours of the morning, and a visit of La Vieille Belgique under the moonlight was a fitting conclusion to one of the most delectable of evenings.

It will interest those American foundrymen who began friendly relations with their European colleagues in 1926 to know the names of those who were present.

Paul Ropsy, Belgium; Mr. and Mrs. Frank Russell, Mr. and Mrs. John Cameron, Mr. and Mrs. William Jolley, Mr. and Mrs. E. Longden, Mr. and Mrs. J. M. Primrose, Great Britain; H. Magdalenat, L. P. Montupet and his son and daughter-in-law, Mr. and Mrs. Montupet; Mr. and Mrs. Claude Primet and their son and daughter-in-law, Mr. and Mrs. Primet; Mr. and Mrs. Paul Thome and Miss Thome, France; Dr. Ing. and Mrs. Gruson, Germany; Mr. T. J. Brons and Miss Brons, Holland; Ing. Carlo Vanzetti and his son, Guido Vanzetti, Comm. Antonio Galtarossa, Ing. Gr. Uff. Amedeo Pellicciotti, his daughter and a friend; Ing. Franco Ratti; Ing. Agostino Rocca, Italy; Mr. and Mrs. Raymond Henry, Luxemburg. V. C. Faulkner, D. H. Wood, V. Delport, who was responsible for the organization of the European delegation in 1926, and Mrs. Delport were invited as guests.

International Committee Plans Future Congresses

DURING the foundry convention at Liege, the International Committee of Foundry Associations held its annual meeting under the chairmanship of Carlo Vanzetti, president. The committee considered the application for membership of the technical foundry association of Poland, and this association was elected unanimously.

The two principal items on the agenda were: the revision of the calendar of future international conventions, and the drawing up of revised by-laws of the international committee.

In connection with the revision of the calendar, the offer of the American Foundrymen's association to hold international congresses in the United States at more frequent intervals than those scheduled in the calendar established in 1926 was put before the committee. The members agreed that this would be in the interest of all, and expressed their gratification at the offer of the American association. The setting up of a final calendar for the next few years was referred to a forthcoming meeting of the international committee, because time did not permit of a full discussion of the matter.

Another meeting of the international committee will be held in Paris in October, during the annual French foundry convention. In the proposed calendars the year 1933 is tentatively set apart for an international congress which may be in the United States. This will be the year of the Pageant of Progress in Chicago.

A draft of revised by-laws of the international committee was circulated. Several points were raised, which also will have to be dealt with by the councils of the individual associations, and it is expected that final by-laws will be adopted at the Paris meeting of the committee.

A. Damour, president of the Association Technique de Fonderie de Paris, unanimously was elected president of the international committee for the next term. The president of the Institute of British Foundrymen in office in 1931 will hold the post of vice-president. Tom Makemson, general secretary of the Institute of British Foundrymen, was unanimously re-elected honorary secretary of the international committee.

The following are the countries that were represented on the international committee, together with the names of the official delegates:

Belgium: J. Leonard, president of the Association Technique de Fonderie de Belgique, Paul Ropsy, past-president of the association, and R. Deprez, general secretary of the association; Czecho-Slovakia: J. Rynder and J. Rittich; France: A. Damour, president of the Association Technique de Fonderie de Paris, E. V. Ronceray, vice-president, and J. Cury; Germany: Dr. Siegfried Werner president of the Verein Deutscher Eisengiessereien, Dr. Geilenkirchen, director of the German association, and J. Langanohl; Great Britain: V. C. Faulkner and John Cameron, past-presidents of the Institute of British Foundrymen; Holland: W. M. Geesteranus, president of the Dutch association, and K. G. Van Nieukirken; Italy, Carlo Vanzetti, representing the Italian foundrymen; Poland: C. Gierdziejewski and J. Buzek; Spain: J. M. Espana; United States: Vincent Delport.

Appoints Executives

Society of Automotive Engineers, 29 West Thirty-ninth street, New York, has appointed John A. C. Warner as secretary and general manager and C. B. Veal as assistant general manager. Mr. Warner will succeed the late Coker F. Clarkson who held the position for 20 years and was the only previous incumbent to the position. The office of assistant general manager is newly created. Prior to his recent appointment, Mr. Warner had served the Studebaker Corp., South Bend, Ind., since Nov., 1926, as research engineer in charge of chassis experimental work and as superintendent of the Studebaker proving ground. He was born in Putnam, Conn., and was graduated from Worcester Polytechnic institute, Worcester, Mass., in 1917 with a B. S. degree in mechanical engineering. He distinguished himself in the service during the World war in the engineering section of the A. E. F. He also has been associated with Borne Scrymser Co., Boston; U. S. bureau of standards, Washington and the Society of Automotive Engineers, New York, as research manager and later as manager of the meetings and sections department. Mr. Warner has been active in the society for many years.

C. B. Veal, newly appointed assistant general manager, was born at Greensfork, Ind., Feb. 23, 1880. He was graduated from Purdue university in 1902 with a B. S. Degree in mechanical engineering. Mr. Veal remained at Purdue university for 15 years following his graduation and instructed in machine and internal combustion engine design and developed courses in gasoline automobile engines and the automobile testing plant. He later served as professor of machine design and also was engaged in consulting work during his stay at the university. He was commissioned a major during the World war and rendered signal service as assistant chief inspection engineer. At the close of the war he became a member of the firm, Manly & Veal, consulting engineers, New York. In 1926 he was appointed research manager for the society, a position which he now holds. Mr. Veal has been active in affairs of the society since 1912 and has served on many committees. He has been active in the Indiana, Buffalo and Metropolitan sections.

Adds to Pig Capacity

Superior Charcoal & Iron Co., Grand Rapids, Mich., has taken over the charcoal pig iron sales of the Newberry Lumber & Chemical Co. This gives the Superior company three furnaces with an annual production capacity of 100,000 gross tons, all operating exclusively on charcoal pig iron.

Questions & Answers on FOUNDRY PRACTICE

GENERAL

Cupola Is Abused

QUESTION

Our castings from the first part of the heat usually are sound, but as the heat progresses they become inferior with gas holes and deposits of slag on the cope side. The iron comes hot at the beginning but gradually grows colder. The slag flows freely. We use a cupola 54 inches diameter lined to 38 inches. Height from bottom ring to under side of tuyeres 20 inches. Six tuyeres 5 x 12 inches inside, 5 x 6½ inches outside. Blast supplied by a fan 48 inches diameter. We use basic iron, No. 2 Foundry iron, nickel-chromium bearing pig iron, steel scrap, car wheels and machinery scrap, good coke and limestone. When ready to charge the coke bed is 63 inches above the tuyeres and 34 inches below the charging door. We use 10 per cent steel scrap in each 1200-pound charge with 240 pounds of coke and 120 pounds of limestone. The cupola lining burns out rapidly and a bridge begins to form above the tuyeres early in the heat. Our heats run from 10,000 to 20,000 pounds.

ANSWER

Some of the facts and figures presented in your inquiry are so extraordinary that we are led to wonder whether you verified them, or merely accepted the offhand statement of one of your workmen. For example a coke bed 63 inches above the tuyeres and only 34 inches below the charging door is exactly the reverse of usual practice. A 240-pound split of coke between the charges is twice what it should be and 120 pounds of limestone is about 4 times the usual amount employed on a 1200-pound charge of iron. You do not give the pressure or volume of the blast, but from other factors presented we are of the opinion that both are too high.

The most logical course for you to pursue is to engage a cupola expert to supervise your melting operations for a couple of days and instruct your cupola man. If you want to experiment yourself, we suggest you cut the bed to 3 feet above the tuyeres. Cut the charge to 700 pounds with 100 pounds of coke and 20 pounds of limestone. Reduce the blast pressure and volume considerably.

By watching the result for a few days you can further readjust these various factors to secure the most satisfactory results. See that the bed is burned through thoroughly before adding the last 4 inches of coke. Then charge material up to the door and let the cupola stand thus for half or three-quarters of an hour before putting on the blast.

THIS department covers all problems relating to metallurgical, melting and molding practice encountered in making steel, malleable-iron and gray-iron castings. Questions submitted by bonafide subscribers to this department will be answered by members of the editorial staff of The Foundry, supplemented where occasion requires by the advisory staff whose personnel is as follows:

John H. Hall
Cast Steel

H. A. Schwartz
Malleable Cast Iron

J. W. Bolton
Gray Cast Iron

All questions should be addressed to the Editor, The Foundry, Penton Building, Cleveland.

Q & A

Ladles Lined by Hand

QUESTION

In lining the small ladles in our foundry we apply a thickness of molding sand by hand and then cover it with fire clay. This operation takes considerable time and we are wondering if American foundry practice has developed a faster or better method.

ANSWER

While in some foundries different materials are employed, the method of application is substantially the same in American foundries as it is in the foundries of your country. In some places molding sand is applied, followed as in your practice by a coat of fire clay in liquid form. In the majority of foundries fire clay by itself, or mixed with sufficient sharp sand, that is silica sand without bond, is applied by hand to the inside surface of the ladle. Clay by itself will crack when dried, but this tendency is offset by the addition of the sand. Many foundrymen apply a coating of blacking before the ladle is dried or afterward while it still is hot.

Q & A

Castings Are Defective

QUESTION

Our castings show sponginess in the bosses and heavy portions. We use 600-pound charges made up of 250 to 350 pounds of pig iron of the following composition: Silicon, 2.40 per cent, sulphur, 0.02 per cent, phosphorus, 0.58 per cent, manganese, 0.80 per cent with the remainder of the charge made up of machine scrap and shop scrap. We use the best grade of coke.

ANSWER

From the weights of the charges we assume that your castings are light to medium weight, probably an average ½-inch section. The mixture you are using is fairly satisfactory for castings of this character. The bosses and heavy parts are porous on account of segregation and the remedy may take one of two forms. Either equalize the thicknesses or tighten up the mixture. If it is feasible to core the bosses, that will cure the trouble by promoting uniform shrinkage. In some instances the same result may be secured by chilling them. The mixture may be tightened up by substituting 10 per cent steel scrap, malleable scrap or pig, or charcoal iron for the same amount of your regular pig iron.

Some foundrymen have secured excellent results by the addition of a small quantity of nickel either in the natural state or in a special pig iron which carries small amounts of nickel and chromium or in a manufactured alloy containing nickel and chromium. Segregation in many instances is cured by sticking a few nails in the affected part. These nails project into the mold cavity and act as internal chillers. Needless to say they must be perfectly clean and dry. Otherwise they will produce blowholes. Preferably they should be tinned. Foundry supply houses carry special large head nails for this purpose. They are used universally in steel foundries and to a considerable extent in gray iron shops.

Q & A

Horn Sprues Made on Job

QUESTION

Can you give us the name of any manufacturer who makes horn sprues for the foundry industry.

ANSWER

A horn sprue is a definitely designed and shaped piece of pattern equipment to fit an individual pattern and so far as we know never yet has been standardized to a point where it can be made in bulk and shipped out like so much bar stock. If a horn sprue is required for a job, the patternmaker makes one to fit that particular pattern. If a number of duplicate horn sprues are needed, the original wood pattern for the horn sprue is taken to the foundry where the desired number are cast in iron, or brass or aluminum, depending on local conditions and the personal preference of the man who is going to use them.

Q & A

Dry Mold for Casting

QUESTION

We are having trouble in securing clean cut lines on the face of general house work castings ranging in thickness from 5/16 to 1-inch. The molds are made in a No. 1 Albany sand and faced with a good grade of plumbago. The sand appears to wash and burn on the face of the casting. We have tried various combinations of new sand and sea coal facing and we have tried working the sand wet and dry, but the results have been the same. Is our practice, or, the sand to blame?

ANSWER

Albany sand enjoys a deservedly high reputation among American foundrymen and for that reason we are inclined to the opinion that in some respect your manipulation must be at fault. A possibility exists that you are applying the swab too freely to the raised ridges of sand forming an ornamental design, and that what you describe as a *wash* or a *burn* really may be a mild form of *scab*. That is a body of sand *boiled* off the face through the action of steam. If you are shaking the plumbago through a bag on to the mold, practically none of it stays on the vertical or nearly vertical faces, therefore these surfaces are not benefited. A facing sand mixture made up of half and half new and old sand with coal dust in the proportion of 1 part coal dust to 10 parts sand, should impart a clean skin to any iron casting up to ½-inch in thickness. The same effect can be secured on gradually increasing thickness of castings up to 1 inch by gradually increasing the amount of coal dust up to a proportion of 1 to 8. Manifestly, Albany sand is expensive in your part of the country on account of the long journey and we are wondering if on that account, you merely are using this sand next the pattern and filling the remainder of the flask with a local sand. If the local sand is *close* or *tight* it will offset the high permeability of the imported sand and cause the mold face to cut and scab. If your local sand is *open*, of course the foregoing objection does not hold. A green sand mold properly made and vented, faced with seacoal facing and plumbago should yield a casting with a clean face. While you are going through an experimental period and endeavoring to find where to lay the blame, you can secure clean castings by spraying the faces of the molds with thin molasses water blacking and then drying them with a torch or a light fire.

GRAY IRON

Castings Resist Heat

QUESTION

Can you give me the proper mixture for grate bars to withstand 2200 to 2400 degrees Fahr.; also stoker tuyeres to withstand from 3000 to 3200 degrees Fahr.? The ones made now seem to burn out too quick. The mixture is composed of 50 per cent light and medium scrap and 50 per cent pig iron containing 2.50 to 2.75 per cent silicon; phosphorus, 0.16 to 0.20 per cent, and manganese, 0.60 to 0.80 per cent. The coke used contains 0.94 per cent sulphur and 11.10 per cent ash.

ANSWER

As far as we are aware there are few metals if any that will withstand temperatures such as you mention for any length of time. However, it usually happens that the design of furnaces is such that the temperatures mentioned are only reached on one part of the casting. The other parts of the casting are in a position to radiate the heat and to a large extent prevent the whole casting from reaching the high temperature.

From our calculations, your present analysis in the casting shows about 1.80 per cent silicon which is rather high for castings subjected to elevated temperatures. We suggest that you reduce this until the fracture appears mottled. White fracture cast iron resists heat better than gray, but it is rather brittle. Therefore, the mottled fracture is suggested. Try your silicon at 1.00 per cent and see what results you get.

Some foundrymen claim excellent results from using about 20 per cent nickel-chromium bearing pig iron in the mixture. Another suggested mixture is composed of 80 per cent steel scrap; 10 per cent of 2 per cent malleable pig iron and 10 per cent of silvery pig iron. One per cent nickel and 0.50 per cent chromium as ladle additions are made to the mixture.

Q & A

Need Good Quality Iron

QUESTION

At the present time we have an order for cast iron flanges suitable for brazing to copper pipe. We would like to know what formula should be used in making the cast iron flanges so that they will braze successfully to the copper pipe.

ANSWER

If the brazing you refer to will be similar to what is known as bronze welding cast iron pipe in which which tobin bronze and a welding torch are used, any strong, close-grained iron will be suitable for the purpose. The tobin bronze requires temperatures from 1400 to 1700 degrees Fahr. for successful work as practiced in welding sections of cast iron pipe together. At these temperatures no difficulty has been encountered from cracking when the work is done by experienced welders.

However, if the brazing you refer to requires the use of a high melting point solder, difficulty may be encountered by the metal cracking under the high temperature necessary to melt the solder. If the whole flang is heated slowly to a fairly high temperature, brazed, and allowed to cool slowly no cracking will take place. Cracking as first mentioned will result from strain induced by unequal heating in only one place (where the brazing is done).

If the brazing solder is similar in composition to tobin bronze which contains 60 per cent copper; 38 per cent zinc and 2 per cent tin, the castings will not crack if the heat is not applied too long in one spot.

Q & A

Reduce Silicon Content

QUESTION

I would like to obtain information on a mixture to produce chilled castings without the use of charcoal iron.

ANSWER

While the use of charcoal iron in the mixture for chilled castings is considered to give better results than the use of straight coke pig iron, a large tonnage of chilled castings is made without any charcoal iron in

the mixture. However, since you do not state the size of the castings you desire to make, it will be difficult to give any but a general answer. In chilled work as in other gray iron castings, the percentage of silicon will vary with the size and thickness of section. The specifications for chilled iron car wheels call for a silicon range from 0.45 to 0.75 per cent; manganese, 0.50 to 0.75 per cent; phosphorus, 0.40 per cent maximum; and sulphur, 0.14 per cent maximum. If your castings are light, the silicon may run to 1.25 per cent, or more. A suggested range for chilled castings is: Silicon, 0.45 to 1.25 per cent; phosphorus, 0.10 to 0.25 per ecnt; manganese, 0.50 to 1.20 per cent, and sulphur as low as possible. Materials used for the mixture may consist of malleable bessemer pig iron, gray iron scrap; steel scrap; chilled car wheel scrap, and return chilled scrap. The percentage of each of these in the mixture will depend on the analysis desired in the finished casting. Since steel contains little silicon, it usually is figured as not containing any. For example to obtain a final analysis of 0.75 per cent silicon; 0.25 per cent maximum phosphorus, and 0.75 per cent manganese, a mixture containing 400 pounds of malleable bessemer pig iron with 1.25 per cent silicon and 2.0 per cent manganese; 200 pounds of steel scrap; 250 pounds of chilled car wheel scrap and 150 pounds of gray iron scrap, should prove satisfactory.

Q & A

Anneals Gray Iron

QUESTION

We are interested in getting some information on the annealing of light and medium weight gray iron castings. Is there any publication covering this subject?

ANSWER

As far as we are aware there there is no publication devoted to the subject of annealing gray iron. However, at various times articles and other data pertaining to the subject have appeared in THE FOUNDRY. In the Aug. 15, Sept. 1, and Oct. 1, 1926 issues, O. W. Potter described an investigation on heat treating or annealing gray cast iron. He found that the best combination of properties was obtained when the castings were heat treated at 1600 degrees for 3 hours and then cooled to a black heat in the furnace. However, this heat treatment is a proprietary process. He also states that to heat treat castings properly, the critical temperature should be ascertained and then the castings heated above this temperature until all parts of the casting are heated uniformly. The method he recommends for determining the critical temperature is: 730 degrees Cent. plus (28 degrees times the per cent silicon) minus (25 degrees times the per cent manganese) in the castings.

Several foundries are annealing their castings at temperatures varying from 800 to 1800 degrees Fahr., the time varying from 5 hours to 1 hour. Factors that enter are the size of the casting, structural condition of the casting (chilled, mottled, hard, etc.) and the results desired. If the castings are small and only moderately hard, a short heat treatment for 1 hour at 1500 to 1600 degrees Fahr. will give good results. If the castings are large or quite hard the time will have to be extended. In some cases a treatment around 800 or 900 degrees may be sufficient. If the castings have a white fracture, a drastic treatment is necessary. This may necessitate the temperature being raised to 1800 degrees Fahr.

Q & A

Gives Melting Rate

QUESTION

We are using a cupola which requires one hour from the time the iron appears to melt 8000 pounds. This appears to be slow work and we want to know if this represents the capacity of the cupola or is there something wrong with our practice? The cupola is 48 inches outside lined to 32 inches inside. Air at 11 ounces pressure is delivered through four 4 x 8-inch tuyeres. The coke bed extends 42 inches above the tuyeres. We use iron charges of 1000 pounds with 135 pounds of coke between charges. The iron comes hot, but if we cut down on the coke the temperature drops.

ANSWER

The makers of the cupola recommend a lining diameter of 37 inches and they give the melting capacity of the cupola as between 5 and 6 tons per hour. On a 32-inch lining the melting capacity per hour is given as between 3 and 5 tons and on that basis your output of 4 tons per hour is fairly representative of the capacity of the cupola. You probably can increase it to the maximum of 5 tons by using smaller charges of iron and coke. However, exceedingly high temperatures and maximum output do not coincide and if your present iron is satisfactory from a temperature standpoint, you probably are getting all the cupola is capable of delivering in the way of tonnage.

Q & A

Chilled Sheave Cracks

QUESTION

We are making a semisteel sheave 13 inches diameter, 2¼-inch face in which the groove is formed with a chill in three sections. With the exception of a slight elevation around the rim and the center the sheave is flat all the way across, top and bottom. This solid body of metal is lightened by a ring chamber core 1-inch thick. In service the chamber is filled with oil which feeds to the shaft through five ¼-inch oil holes. Although we extract the chills as soon as possible, the casting cracks radially on the cope side of the groove. We shall appreciate your suggestion on how to prevent this trouble.

ANSWER

Your trouble is due to unequal contraction between the rim and the body of the casting and is aggravated instead of minimized by removing the chills. Ideal conditions depend on a uniform cooling speed for the entire casting and manifestly this is impossible where the light rim is chilled while the comparatively heavy center remains hot. If some method could be devised to keep the rim as hot as the center the entire casting would contract uniformly. Unfortunately this is not practical. Therefore the remaining alternative is to cool the center artificially and as rapidly as possible. When the casting has set, turn the mold up on edge, strip the sand away from the center, top and bottom and dig out the core. This will equalize the cooling speed. Fins between the chill sections or over the top edge tend to start cracks. See that the ends of the chills touch closely. If necessary enclose them in a loose steel band with a few wedges. Also see that the cope bears firmly on the upper edge. Coat the chills with a creamy mixture of oil and blacking and dry in the oven.

MALLEABLE

Will Add Ferroalloys

QUESTION

Please advise the proper methods of making additions of ferrosilicon and ferromanganese to the iron charge in malleable air melting furnace. What grade of alloys should be purchased, and should they be lump or powdered? When using fused sodium carbonate as a fluxing agent, what loss in the various elements takes place? What is the best method of using the carbonate to effect the reduction of sulphur in the malleable air furnace?

ANSWER

Either ferrosilicon or ferromanganese is added to a clean bath, preferably some 20 or 30 minutes before tapping. If the bath is clean it makes no difference whether lumps or powder is used. If slag is on the metal, lumps are preferable. It is usual to use 50 per cent ferrosilicon and 70 to 80 per cent blast-furnace, ferromanganese, the latter containing about 7 per cent carbon.

Sodium carbonate usually is recommended for addition at the rate of about 2 pounds per ton of metal, sometimes more. A few persons recommend charging it with the heat so that it becomes part of the first slag and is then removed. More generally it is added after removal of the first slag. It removes some sulphur and is believed by some to remove oxygen, which is doubtful.

The FOUNDRY Family Photograph Album

Upper Left

L. R. ZIFFERER

Columbia Malleable Casting Co., Columbia, Pa.

Upper Right

FRANK HUDSON

Fordath Engineering Co. Ltd., West Bromwich, England

Lower Left

R. J. BURROWS

Clark Tructractor Co., Battle Creek, Mich.

Lower Right

J. H. WARE

Fulton - Harwood Brass & Aluminum Co., South Bend, Ind.

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

MONEL METAL AND NICKEL FOUNDRY PRACTICE

(*Concluded from Data Sheet No.* 822)

over 0.5 per cent sulphur, is the only fuel recommended. Coal and coke are particularly harmful because of their high sulphur content. In the oil-fired furnaces no slag is added, the only slag present coming from the crucible or sides of the open-hearth furnace. The same applies to the indirect arc rotating electric furnace. In electric furnaces of the regular arc type, a slag of equal parts of lime and silica sand is thrown on the bath when the charge partly is melted. The principal purpose for this slag addition is to steady the arc and thereby prevent the continued making and breaking of the arc. No furnacing other than melting is necessary as the metal as supplied to foundries is of sufficient purity to need no subsequent refining. No additions, except silicon and magnesium, are required.

For most castings monel metal should be poured at a temperature of 2700 degrees Fahr. (1482 degrees Cent.) to 2750 degrees Fahr. (1510 degrees Cent.) but for light castings the temperature should be about 2800 degrees Fahr. (1538 degrees Cent.). Nickel should be somewhat hotter than monel metal, the heavier castings being poured at 2800 degrees Fahr. (1538 degrees Cent.) to 2850 degrees Fahr. (1566 degrees Cent.), and the light ones at 2900 degrees Fahr. (1593 degrees Cent.).

Monel metal and nickel both being harmfully susceptible to the actions of gases, all possible care should be taken to permit the easy escape of the gases. For the same reason, the use of gas-producing ingredients in molding materials should be reduced to a minimum. Manganese and sulphur are both detrimental, manganese causing the metal to cut the sand badly and causing heavy shrinks while sulphur in excess of 0.030 per cent makes the metal hot-short and brittle. A good grade of refractory molding sand should be used for the molds.

Because of their high shrinkage, monel metal and nickel castings are likely to develop shrinks and pulls which often can be overcome by a change of molding practice, the use of heavier fillets, a change of mixture, the elimination of all or part of the scrap used in the charge or a change in the core when present to permit the castings to solidify without any strain being set up by the excessive hardness of the core. Scrap should be kept down to a minimum and should not exceed 25 per cent of heavy scrap or 10 per cent of light scrap. The use of excessive quantities of scrap is frequently responsible for heavy pulls and sometimes causes porosity, by oxidation of the silicon and the evolution of gas picked up during remelting.

Melting should be accomplished as quickly as possible but not at so fast a rate as to oxidize the metal. In the crucible pits about 2 hours should be necessary to melt monel metal in crucibles containing 175 pounds of metal, and slightly longer for nickel. This melting rate applies to a hot furnace. Obviously, the first melt will require a slightly longer time.

The most important factor necessary for the production of good monel metal or nickel castings is suitable equipment. Without the proper furnaces no amount of good molding or foundry practice will make satisfactory castings.

PROPOSED TENTATIVE SPECIFICATIONS FOR

AUSTENITIC MANGANESE STEEL CASTINGS

1. These specifications cover austenitic manganese-steel castings; this material is also often referred to as Hadfield's manganese-steel.

MANUFACTURE

2. The steel shall be made by one or more of the following processes: open hearth, electric furnace, converter, or crucible.

3. The castings shall receive a suitable heat treatment to render them tough and ductile. This heat treatment shall consist of uniformly heating the castings to a temperature of at least 1000 degrees Cent. (1832 degrees Fahr.), holding them at the maximum temperature until they are uniformly heated throughout, and quenching them in water.

CHEMICAL PROPERTIES AND TESTS

4. The steel shall conform to the following requirements as to chemical composition:

Carbon	1.00 to 1.40 per cent
Manganese	10.00 to 14.00 per cent
Phosphorus	not over 0.10 per cent

5. An analysis of each melt of steel shall be made by the manufacturer to determine the percentages of the elements specified in Section 4. This analysis shall be made from drillings taken at least ¼-inch beneath the surface of a test ingot obtained during the pouring of the melt. The chemical composition thus determined shall be reported to the purchaser or his representative, and shall conform to the requirements specified in Section 4.

6. Analysis may be made by the purchaser on samples obtained from a casting. The samples for analyses shall be taken not less than ¼-inch below the surface in the case of rough castings. In the case of castings finished by grinding or machining, the samples for analysis may be taken at the finished surface, provided at least ¼-inch of metal has been removed from the casting at the point selected for sampling. The phosphorus content thus determined shall not exceed 0.11 per cent. The carbon content thus determined shall not be less than 0.90 per cent nor more than 1.50 per cent.

NOTE.—Contamination of the drillings by drill chips must be carefully guarded against. Flat drills of the best high-speed steels, or drills of some of the newer tool materials, will generally be satisfactory for drilling manganese steel. Manganese steel may be drilled best after it has been annealed for several hours at from 500 to 600 degrees Cent.

PHYSICAL PROPERTIES AND TESTS

7. (*a*) Bend tests shall be required only when specified in the purchase order.

(*b*) When bend tests are specified, the test specimens shall stand being bent cold without breaking, around a pin 1 inch in diameter, to an angle of

This tentative specification is abstracted from the report of committee A-1 on steel presented at the recent meeting of the American Society for Testing Materials held in Atlantic City, N. J., June 23 to 27. Criticisms are solicited and should be directed to V. H. Lawrence, secretary of committee A-1 on steel, Alan Wood Steel Co., Conshohocken, Pa.

(*Continued on Data Sheet No.* 825)

Problems in Nonferrous Founding

By Charles Vickers

Withstands Steam Action

We would like to get a bronze mixture that will stand up under superheated steam and 700 pounds pressure. We are now using a mixture of 86 copper, 4 zinc, 6 tin, 3 lead, 50-50 copper-nickel shot, 1 per cent. The castings are simply eaten away by the steam.

Use the following alloy, which seems to give good results in the case of other founders: 81 per cent copper; 8.5 per cent nickel; 7 per cent tin, and 3.5 per cent zinc.

Q & A

Makes Ornamental Work

We are making such ornamental brass work as tablets and nameplates, but a large percentage of the castings are porous in some of the heavier sections. We use a fine Albany and a French sand mixed to the proper proportions and we thoroughly dry the molds, usually to a dark chocolate brown, but sometimes to a black in spots. Therefore we feel that our metal mixture has something to do with the porosity of the castings. We use a straight 85-5-5-5 ingot but the general idea in our factory is to add lead to make the metal run more freely. However, in consulting the book "Metals & Their Alloys" we find that little lead is used in this class of work. Rather the addition of zinc seems advisable. We would appreciate any information as to the action of lead in tablet castings. We have examined the castings for lead sweating but this condition does not exist.

A mixture frequently used for tablets consists of 90 per cent copper; 7 per cent tin, and 3 per cent zinc. Sometimes it is changed slightly as for instance to 90 per cent copper; 6 per cent tin; 3 per cent zinc, and 1 per cent lead. This change produces a metal that is more easily worked due to the lead, than is the first alloy mentioned. It generally is conceded that the copper content of bronze used to make artistic castings should be always above 88 per cent. Also that the metal should be new, neither scrap metal nor remelted ingots being used. Another suitable alloy containing 89.5 per cent copper; 5 per cent tin; 5 per cent zinc, 0.5 per cent lead, and still another choice consists of 89 per cent copper; 6 per cent tin; 3 per cent zinc, and 2 per cent lead.

Any of the above alloys will give good results. After return metal has accumulated and a proportion has to be used in each heat, it will be advisable to melt it with the copper part of the charge, putting it in the bottom of the pot as this helps the copper to melt more quickly. In all new heats be careful the ingot copper does not come into contact with the flame when in the furnace. If crucibles are used in coke-fired furnaces always place a deepener on top of the crucible, then the copper can be all charged at once when cold. Protect the copper with a few hardwood blocks on top of the charge. In oil-fired rapid melting crucible furnaces, charging ingot copper, put no more copper in the pot than will lie inside it, and add other ingots as the first charge sinks and before it liquefies. If a 200 pound pot can be melted in one hour and ten minutes starting cold, charge a handful of borax with the copper. When the metal is nearly ready to pour add one ounce of phosphor copper containing 15 per cent phosphorus to each hundred pounds of bronze. Allow a time limit of 10 minutes between this addition and pouring the mold. That period of time will be ample for the phosphorus to deoxidize the metal properly.

While the sand mixture is quite suitable it is a good idea to use a vent wire on the mold to assist the get-away of the gasses generated. In melting with oil or gas, remember that an oxidizing flame is superior from the viewpoint of results, than a reducing flame, and that by all means get the metal hot in the furnace, and cool to suit the pouring. There is no such thing as overheating the metal in the furnace. All that is required is protection against the furnace atmosphere. The melting of bronze is similar to the melting of iron as regards heat. Iron has to be brought down hot in the cupola, and brass and bronze must be brought out hot from the furnace.

The addition of lead in the case of such castings is not advisable as all that is gained is a little cheapening of the alloy, lead is no fluidizer, tin is the fluidizer, but the above alloys contain all the tin that is necessary. Lead usually is added to make the metal easier to machine, but for the work in hand it is not necessary. For such work the cheapest alloy is never the best. The costly thing is not the metal but the molding costs encountered.

Q & A

Nickel Will Help

We have on hand some good steam metal chips that have become mixed with about one per cent of a nickel alloy consisting of 62 per cent copper; 30 per cent nickel and 3 per cent iron. The composition of the steam metal is 86 per cent copper; 8 per cent tin; 4 per cent spelter and 2 per cent lead. We are wondering whether the nickel alloy will be harmful to the red metal, and if so how we can eliminate it.

Inasmuch as nickel is quite frequently added to steam metals, and similar alloys used under pressures of air and steam to increase their density and so reduce the percentage of leakers, it is our opinion that the admixture of around 1 per cent of the alloy in question will prove beneficial.

The small percentage of iron carried in by the alloy can be ignored for as it is alloyed with the nickel mixture it is not likely to segregate in the steam metal and form nodules. Being alloyed its effect is in the direction of increased density, which is a valuable property where pressure castings are concerned. The element to fear is aluminum. It is quite a common practice to add this metal to cast nickel alloys so they will flow better in the mold, but even traces of it will injure any red alloy for pressure resistance. We would suggest making sure on this point by picking out sufficient of the nickel alloy chips for an analysis and have a complete analysis made. If no aluminum is found, the nickel alloy can be used in admixture with complete confidence. Steam mixtures to be used for superheated steam, frequently carry as high as 8 per cent of nickel. The cost of an analysis is small and of no consequence when compared with the satisfaction of knowing just what one is doing. The analysis of the nickel alloy you quote is merely a typical one of the alloy in question, and it may or may not be correct as applied to the alloy from which the chips have come.

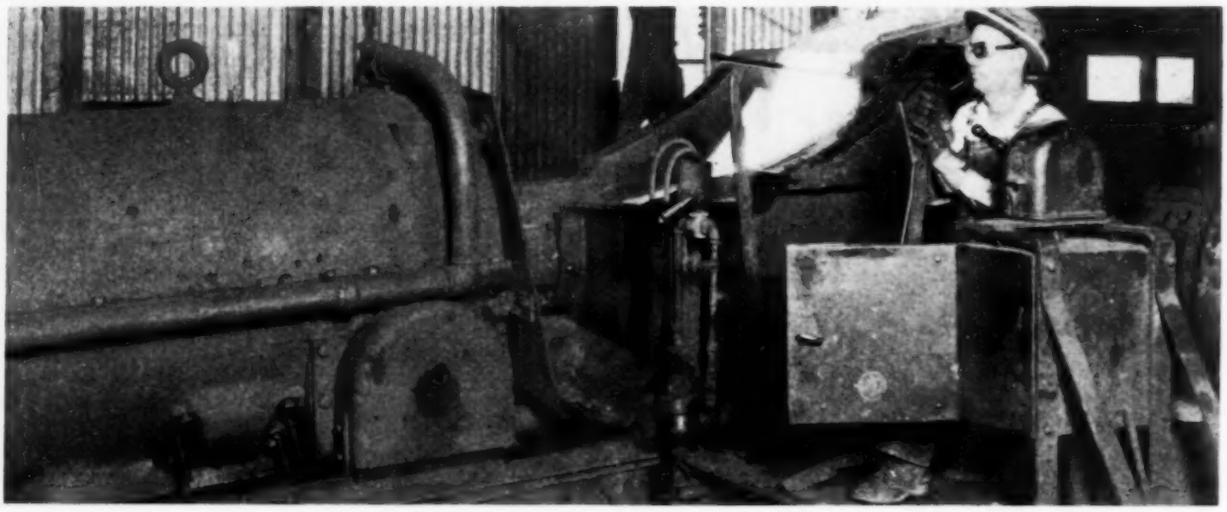


Fig. 1—All Controls Are Grouped at One Station Within the Reach of a Single Operator

CASTS PIPE in Eighteen Foot Lengths

By Pat Dwyer

EXPERIENCE gained over a period of many year's intimate contact with the pipe casting industry, stood a group of men in good stead when they decided in 1913 to establish a new pipe making plant in Birmingham, Ala., under the title of the National Cast Iron Pipe Co. They were enabled to incorporate in the design of building and equipment all the desirable features which had proved their worth, and to omit other features, excellent in themselves, but not in harmony with the latest developments in the industry.

To provide for future expansion, for unforeseen contingencies and on the broad general principle that the

Fig. 2—Battery of Molds, Looking Toward the Annealing Furnaces. In the Mold to the Left the Pouring Operation Is Almost Complete. In the Central Mold the Operation Is Finished and the Surplus Metal in the Spout Is Flowing into a Basin on the Floor

Far West is not the only section of the country where wide open spaces are appreciated, the plant was erected in the center of a piece of property containing at first approximately 50 acres in the northeast section of the city and served by a branch of the Louisville & Nashville railroad, better known over a period of many years simply as the L. & N. Since that time 41 acres have been added for tenant houses and expansion.

Substantial brick and steel buildings, well lighted and ventilated, house the various activities. In the state of Alabama, artificial heating of foundries is not regarded as a factor of major importance. In the National, as in other plants in the South, castings are cleaned, inspected and dipped in sheds that merely are roofs supported on suitable columns. At some periods during the summer, the heat is a greater burden and interferes with the work to a greater extent than the cold in the winter. The main buildings are constructed substantially of brick and steel and include a pit foundry, a fittings foundry and a new shop where pipes are cast centrifugally.

Must Stand Heat

In this connection it is interesting to note that, contrary to a somewhat popular belief, the negro workman is not immune to high temperatures. Resistance of individuals vary and, of course, one is not justified in drawing conclusions from a few isolated cases. Obviously, also one might fall into error in drawing comparison between white and colored men in their ability to endure high atmospheric temperatures, since only rarely are they engaged in exactly the same duties. For this passing comment it is sufficient to note that the term *white-eye* is a standard local idiom. It refers to a negro who has collapsed from the heat and is based on the fact that the eyes roll upward during the spasm, thus exposing the white surface.

Prevention of white eye was one of the features kept in mind in the erection and operation of the National Cast Iron Pipe plant on a wide and spacious area. The same kindly interest in its workmen, prompted the erection of a large number of dwellings on its property. Relations between management and workmen have been maintained on a particularly harmonious scale and these relations have been promoted to a considerable extent by community activities and the development of a local community spirit.

Built originally for an output of 250 tons per day of cast iron pipe poured vertically in dry sand molds, the plant was operated practically without change until 1923 when several machines were installed to make pipe centrifugally according to the deLavaud process in 12-foot lengths. Sublicence for manufacturing pipe according to this process was secured from the United States Pipe & Foundry Co., holders of the original licence under the deLavaud patent for making pipe of this character in the United States.

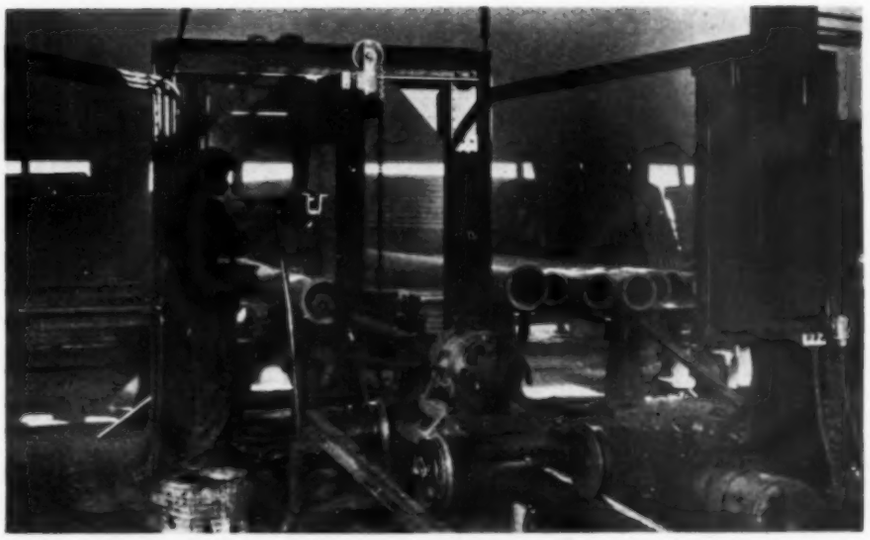


Fig. 3—A Motor Driven Grinding Wheel Mounted on a Carriage Smooths the Interior Surface of Each Pipe

A new building for the centrifugal department was erected a short distance to the east of the pit foundry and was equipped with the necessary machines, melting plant, annealing ovens, cleaning and inspection departments. The plant was erected and has been operated as a complete, selfcontained unit. On a floor area less than one tenth of the pit foundry, the production of centrifugally cast pipe, has exceeded the output of the pit shop two to one.

The original installation of four machines was designed for the production of pipes 12 feet in length and graduated in diameter by 2-inch steps from 4 to 12 inches. Machines for 14 to 20-inch sizes were put in 4 years later. Recently two additional machines have been installed for the production of 18-foot lengths. The new machines are of the latest type and are direct motor driven. In the original installation the spinning motion is accomplished through a Pelton wheel actuated by a stream of water under high pressure. Pumps for maintaining pressure in the water lines are housed in a neighboring building which also contains the air compressors, and electrical control equipment.

Explains Centrifugal Machine

General features in connection with the operation of the mold were presented in the third section of the present series, which appears in the May 15 issue of THE FOUNDRY and covers the installation at the plant of the United States Pipe & Foundry Co., Birmingham, Ala. The following brief summary will serve in the present instance.

The deLavaud centrifugal casting machine is made up of three main parts: The steel mold cylinder, the driving and cooling system, and the pouring mechanism. The ends of the

Fig. 4—A Special Device Suspended from a Crane Dips the Hot Pipes Into a Vat of Liquid Pitch

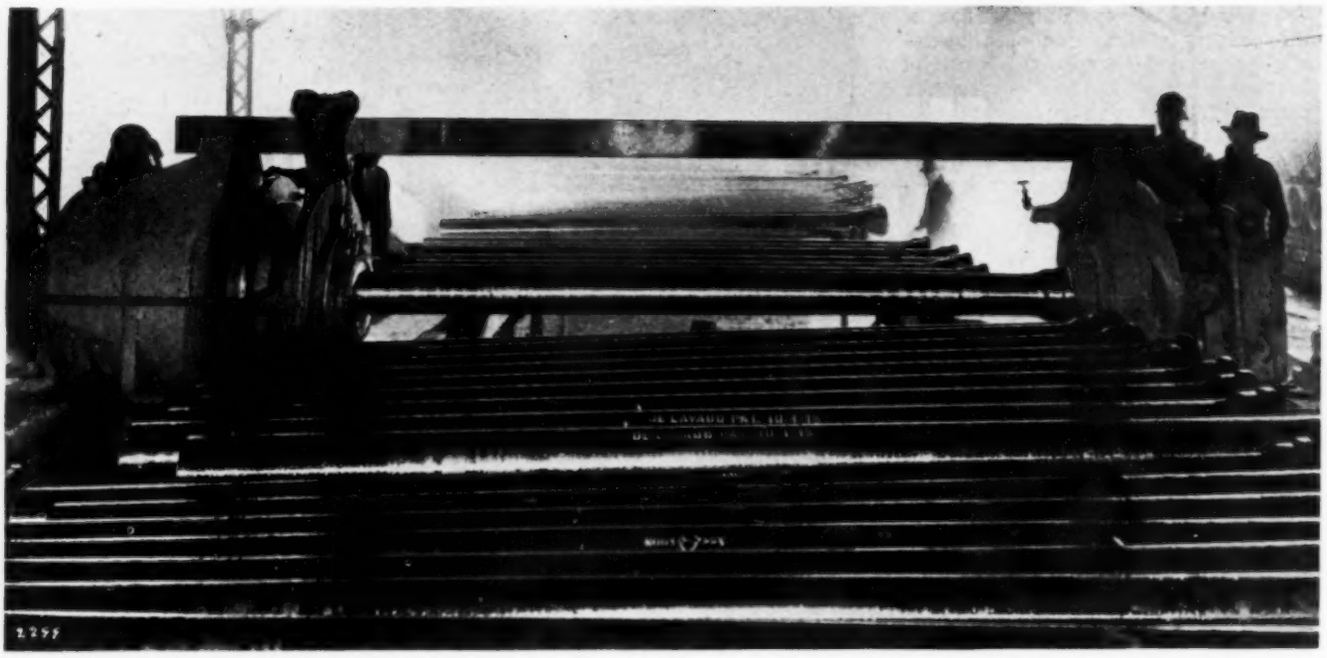


Fig. 5—Each Pipe in Turn as it Rolls Along the Skidway Is Clamped to a Hydraulic Testing Machine and Subjected to an Internal Pressure of 500 Pounds per Square Inch

mold revolve in accurately machined bearings in the ends of a cylindrical cast iron jacket, supported in turn on a carriage which conveys the mold to and from the pouring spout. The space between the mold and the jacket is filled with water and is divided into two compartments. One contains the Pelton wheel at the lower or bell end of the mold. The main compartment receives its cooling water independently through a pipe on the bottom perforated in a manner to insure even distribution irrespective of the position of the mold.

Longitudinal movement of the mold is accomplished through a two-part, telescoping, hydraulic ram which continually adjusts itself to the position of the mold. Part of the movement of this ram is automatic and part is controlled through a valve at the pouring station. The pipe which supplies water to the Pelton wheel, passes through the interior of the ram and also is built on the telescope principle. Each machine is equipped with two gages, one to register the pressure and the other the temperature of the water.

Must Synchronize Movements

Three movements must synchronize for the machine to function properly. One is the tilting speed which regulates the flow of iron from the ladle. The second is the longitudinal speed of the mold in its movement past the pouring trough. The third movement is the spinning movement, or the number of revolutions of the mold per minute.

The speeds differ for each size of pipe, but the tilting speed and the longitudinal speed are based on the spinning speed. On a given size pipe, a change in the speeds will affect the thickness of metal in the pipe wall.

Pouring mechanism for each machine includes a tilting ladle, a spillway and a long narrow trough which terminates in a short spout attached at right angles to deliver the metal against the face of the mold. The preparation for pouring each casting, the mold is advanced its full lengths toward the pouring station. This movement automatically brings the spout on the end of the pouring trough close to the lower, or bell end of the mold. Thus when pouring commences, the first metal is delivered close to the bell end. The rapidly spinning mold then begins its longitudinal movement away from the pouring station and consequently the metal from the spout is delivered against the face of the mold in a constantly advancing spiral until the mold reaches a point beyond the reach of the trough and spout. The pouring basin is actuated by a hydraulic cylinder under needle valve control and may be adjusted to pour at any desired speed. The required quantity of metal is placed in the pouring basin from a crane ladle which serves several machines. A sand core is inserted for each casting in the end of the mold to form the inside of the bell end. These cores are made and dried in large numbers and are held in place by a quick acting clamp and wedge, easy to apply and easy to remove.

A delicate balance has to be maintained at all times between the temperature of the iron, the pouring speed and the temperature of the mold. This balance is necessary not

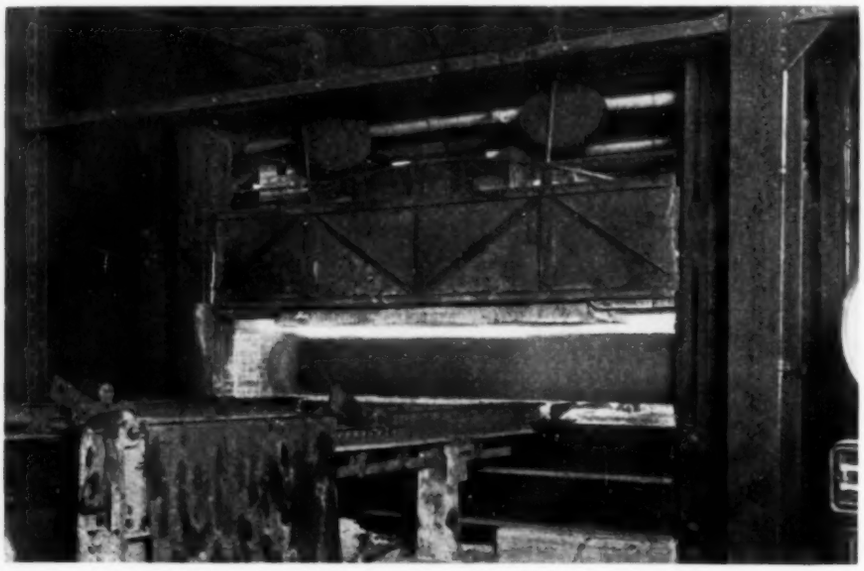


Fig. 7—A Manipulator Receives the Glowing Pipe From the Crane and Rolls it Into the Annealing Furnace

only to the production of sound castings, but also to conserve the life of the molds. A special alloy steel mold operating under ideal conditions has a life expectancy of approximately 8000 castings. However, a comparatively slight variation in the operating temperature will wreck it in a short time. Experience has shown that the most satisfactory operating temperature of the mold is between 130 and 150 degrees Fahr. Below this temperature, the mold adversely affects the fluidity of the metal poured into it. At a higher temperature the face rapidly disintegrates.

Few Men Needed

On the basis of tonnage produced, the number of men required in a centrifugal casting plant is almost negligible. Through a number of control levers as shown in Fig. 1, one man regulates the action of the pouring basin and mold. An attendant at the opposite end attaches the bell cores while a second removes the pipe from the mold. An attendant at the pouring end, greases the entrance to the mold and brushes the pouring trough with wet blacking each time before the mold is set to receive the molten iron. The blacking dries immediately in the hot trough and prevents a skin of iron from forming over the surface. The grease on the end of the mold serves the same purpose. The utmost cleanliness is required in the operation of a mold that may be used from 20 to 50 times per hour, throughout the day.

Pipes at a bright red heat are ejected from the molds and picked by a pair of special flat hooks, suspended from an equalizer beam hanging from a crane which takes them to one of the annealing furnaces which may be noted in the background Fig. 2. The photograph for this illustration was taken from the charging platform of the cupolas. The foundation for a new annealing furnace may be seen at the extreme left. This has been completed and placed in service since the material for the present series of articles was collected. The annealing furnaces at this plant and at others in this country where pipe are made according to the deLavaud process were designed and erected by the Ryans Scully Co., Philadelphia.

Fig. 8—The Building in Which the Pipes Are Dipped and Tested Is Open on Both Sides for Practically Its Entire Length

To remove a slight surface chill and to insure a thoroughly homogenous structure, the newly cast pipes are subjected to an annealing temperature of 1750 degrees Fahr., for a brief period in a 30-minute journey through a gas fired annealing chamber. They enter the furnace at a temperature of approximately 1100 degrees, immediately after they are taken from the molds. In the furnace the pipes rapidly rise to a temperature of 1750 degrees and then enter a zone where the temperature steadily decreases. During their passage through the annealing furnace the pipes are supported on revolving wheels or rollers, which keep them in constant motion and prevents them from sagging at a comparatively high temperature.

As mentioned elsewhere, by-product coke gas is cheap and abundant in the Birmingham district. The rate varies in accordance with the volume consumed and may be as low as 18 or 19 cents per thousand feet in plants similar to the National Cast Iron Pipe Co., where it is employed extensively.

Test the Pipe

The pipes emerge from the annealing chamber at a temperature between 800 and 900 degrees Fahr., and roll on to a continuous rail skidway which carries them past the chipping and grinding stations, the dipping tank, the testing machine, to the shipping platform while they still are hot. In loading the pipe for shipment, every second pipe is turned end for end so that bell and spigot ends may alternate in the

Fig. 6—A Socket Core Is Placed in the Bell End of the Mold Each Time Before the Iron Is Poured Into the Mold

Fig. 9—Bell End Cores Are Rammed by Hand in Split Boxes at the Rate of About 500 Per Day for Each Operator

row and thus conserve space in the car. Before they arrive at the loading stage, the pipes move forward side by side consistently with all the bells touching.

This arrangement facilitates the work of the grinders and testers. Each pipe is subjected to two grinding operations. In one a small grinding wheel is utilized to smooth the interior of the bell and to make an absolutely true, flat seat at the bottom of the socket. In the second grinding operation, a small wheel on the end of a long shaft moves through the pipe from end to end and removes any slight deposits of slag incident to the centrifugal process of casting, whereby any impurities in the metal automatically come to the surface on the inside of the tube. The pipe reposes on rollers slightly higher than the skidway during the grinding process and consequently is made to revolve rapidly in the opposite direction to the grinding wheel. The style of equipment and the method of operation are shown in the illustration Fig. 3. A third similar machine is utilized to drive an expanding revolving metal brush through the pipe to clean it out.

Are Closely Inspected

Pipes are inspected practically at every stage of their passage between the mold and the loading station. They are inspected for surface flaws before they are dipped in a vat filled with a pitch compound and they are inspected and tested for internal defects after they have been removed from the bath. A special device shown in Fig. 4 is employed for dipping the pipe. The rails of the skidway extend over the tank, with a break at one point to accommodate the dipping device. Thus the pipes are rolled directly on to the device at one side of the tank and removed at the other side after they have been coated. On the second section of the skidway, the surplus coating drains from the pipes and falls back into the tank while the pipes are moving toward the testing station.

In the quick acting, hydraulic testing machine, shown in Fig. 5, the pipes are subjected according to classification to an internal pressure of 500 to 800 pounds per square inch. The heads on this machine are adjustable to accommodate pipe of various sizes. The machine spans the skidway in such a manner that the pipes roll into place automatically. Subject to the discretion of the customer's inspector a certain number of pipes from each lot are subjected to a hammer test while under pressure. This test is very severe. The inspector walks from end to end of the pipe and raps the top smartly with a hammer at intervals of a few inches. As with other specifications covering the manufacture of cast iron pipe, the tests exceed anything to which the pipes may be subjected in service.

After the pipe has received the final test it is stenciled in white paint with the name of the manufacturer and the date. Also a legend carrying the name of the inventor of the process and the date on which the patent was granted in the United States.

Iron for the centrifugal casting department of the National Cast Iron Pipe Co., is melted in a battery of four cupolas erected outside the south wall of the building. These cupolas, two 66-inch and two 72-inch inside diameter, with bustle pipes and pendent tuyeres, blast furnace style, were fabricated by the company in its own shops. These repair and maintenance shops constitute an important factor in the general operation of the plant. They are in effect, general jobbing shops and probably cover a wider range of activity than falls to the lot of the average commercial jobbing plants.

The cupolas are used in pairs on alternate days. They are lined and repaired with sand stone from a deposit on the company's property. It is claimed that this form of lining gives better satisfaction than any other which has been tried. Clay for daubing the lining and for adding to the molding sand in the form of claywash, also is secured from a local source. It is extremely sticky and yet it is sufficiently refractory to make an excellent component in the loam mixtures from which the cores in the pit shop are made.

Make Up Charges

Two positive pressure blowers made by the P. H. & F. M. Roots Co., Connersville, Ind., supply air for the cupolas through a common blast main provided with suitable gates for diverting the blast to any single, or any combination of cupolas.

Charges are made up by a magnet and crane in the stockyard, which load the material into steel pans that are weighed and lifted to the charging platform by the same crane and placed on small buggies. Coke is forked into the cupolas, but the iron is dumped mechanically. A steel cable extends from side to side of the charging room close to the front of all four cupolas. A small air hoist is suspended by a trolley

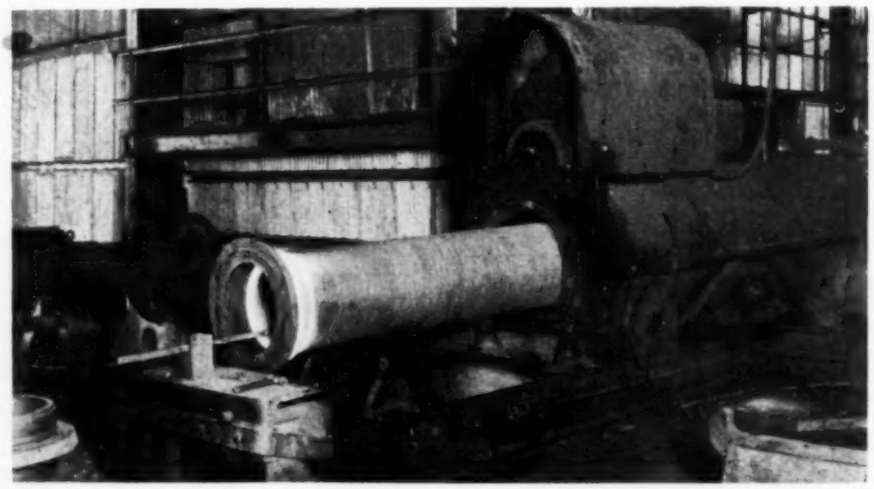


Fig. 10—In the Later Type of Mold an Electric Motor Through Suitable Gearing Imparts the Spinning Motion

from this cable. The operator pulls the hoist along the cable until it is above any of the pans to be dumped into any of the cupolas. He hooks the hoist to the back of the pan and dumps the contents into the charging door of the cupolas.

Operating, equipment and materials of the pit shop and the shop where standard and special pipe fittings are made, will be described in a succeeding article.

This is the fifth of a series of articles dealing with the cast iron pipe industry in the South. Succeeding articles are scheduled for publication in early issues of The Foundry—The Editors.

Preventing Unsoundness in Bronzes

(*Concluded from Page* 87)

An oxidizing atmosphere, for example, may consist of 4 per cent oxygen, 13 per cent carbon dioxide, and the remainder nitrogen. The gases and air before ignition are a mixture of all types, for example, oxygen and nitrogen (air is composed of 20 per cent oxygen and 80 per cent nitrogen) with the combustible reducing gases, such as methane and carbon monoxide. It takes some time for combustion to become complete, the speed of flame propagation depending on the effectiveness of the gas mixing in the burners, the degree of preheat, the velocity of the gases, the shape and volume of the combustion chamber, and the length of travel through the furnace.

To combustion engineers an oxidixing atmosphere means an excess of air and a reducing atmosphere indicates excess of fuel for perfect combustion. However, as pointed out by Darby in Technical paper No. 302, American Institute of Mining and Metallurgical Engineers, 1930, another definition should be given consideration. He states that to the foundryman neutral atmosphere generally is considered as the atmosphere of the furnace that will produce melted bronze that is neither oxidized or gassed. The charge being melted in the furnace may contain elements which are chemically inactive at normal temperatures but which will form compounds at the elevated temperatures of the molten bath, or even at lower temperatures. For example, carbon dioxide usually considered neutral by the combustion engineer may oxidize some of the zinc of the charge.

Attainment of neutral melting atmospheres necessitates proportioning burners which maintain the ratio of fuel to air constant, and which intimately mix the fuel and air to insure rapid and complete combustion. In oil burning systems a high degree of atomization is desirable and this is obtainable in high pressure systems. Lighter oils are desirable although not essential in all cases. It is only within the last few years that really practical proportioning burners for gas have been brought out.

When the fuel and air are proportioned to produce a neutral atmosphere after combustion, the mixture is explosive. A furnace operating neutral and being crowded tends to roar and vibrate, with a short clear flame clinging to the exhaust port of the furnace. A mixture resulting in an excess of reducing gases produces a soft long luminous flame. When excess oil is used smoking may be observed. With excess gas the flame is long, blue, or even yellowish. When the combustion products have an excess of air the flame is short, or *within the furnace* and the green of burning copper is noticeable. In high zinc alloys excessive volatilzation of zinc oxide is noticeable.

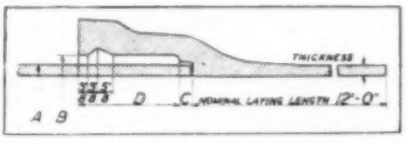


Fig. 11—*Points of measurement of centrifugally cast pipe*

Celebrate Seventy-fifth Year of Operation

Crane Co., Chicago, on July 4 celebrated the seventy-fifth anniversary of the founding of the business with a banquet for veteran employes of the company. The banquet was held at the Stevens hotel, Chicago, and was attended by approximately 1500 including employes and guests. July 3 was set aside as a holiday for Crane employes all over the world in commemoration of the anniversary.

The *Valve World*, publication of the Crane Co., published a special edition of 201,000 copies as a special feature of the celebration of the anniversary. The publication traces the history from the founding in 1855 to the present widespread organization. Photographs of the various plants of the company and the processes carried out are included.

Starts Brass Foundry

The Great Lakes Chemical Works, 5440 W. Jefferson avenue, Detroit, has installed a nonferrous foundry department to manufacture cored and solid phosphor bronze bushing bars in 12-inch lengths. This foundry work supplements the company's previous production of babbitt metal, solder, etc. H. Jacobson is secretary-treasurer of the company.

Dimensions of Pipe According to Working Pressure

Diameters from 4 to 20 inches

Nominal Diameter Inches	Class or Maximum Working Pressure	Dimensions in Inches				Average Thickness	Weight of Pipe Pounds	Weight Per Foot Including Bell
		A	B	C	D			
4	50	4.80	5.60	.30	3.00	.30	175	14.6
4	150	4.80	5.60	.30	3.00	.34	200	16.6
4	250	4.80	5.60	.30	3.00	.37	215	17.9
6	50	6.90	7.75	.375	3.50	.32	280	23.3
6	150	6.90	7.75	.375	3.50	.36	310	25.8
6	250	6.90	7.75	.375	3.50	.40	340	28.3
8	50	9.05	9.85	.375	4.00	.36	410	34.2
8	150	9.05	9.85	.375	4.00	.38	435	36.3
8	200	9.05	9.85	.375	4.00	.42	475	39.6
8	250	9.05	9.85	.375	4.00	.46	515	42.9
10	50	11.10	11.90	.375	4.00	.39	540	45.0
10	150	11.10	11.90	.375	4.00	.42	585	48.7
10	200	11.10	11.90	.375	4.00	.48	657	54.7
10	250	11.10	11.90	.375	4.00	.52	705	58.7
12	50	13.20	14.00	.375	4.00	.42	700	58.3
12	150	13.20	14.00	.375	4.00	.46	765	63.7
12	200	13.20	14.00	.375	4.00	.52	850	70.8
12	250	13.20	14.00	.375	4.00	.58	935	77.9
14	50	15.30	16.10	.50	4.00	.44	848	70.7
14	100	15.30	16.10	.50	4.00	.50	931	77.6
14	150	15.65	16.45	.50	4.00	.55	1065	88.7
14	200	15.65	16.45	.50	4.00	.62	1186	98.8
16	50	17.40	18.40	.50	4.00	.45	1000	83.3
16	100	17.40	18.40	.50	4.00	.52	1135	94.6
16	150	17.80	18.80	.50	4.00	.60	1325	110.4
16	200	17.80	18.80	.50	4.00	.66	1442	120.1
18	50	19.50	20.50	.50	4.00	.48	1190	99.2
18	100	19.50	20.50	.50	4.00	.56	1367	113.7
18	150	19.92	20.92	.50	4.00	.64	1579	131.6
18	200	19.92	20.92	.50	4.00	.71	1740	145.0
20	50	21.60	22.60	.50	4.00	.50	1381	115.0
20	100	21.60	22.60	.50	4.00	.59	1599	133.2
20	150	22.06	23.06	.50	4.00	.69	1904	158.7
20	200	22.06	23.06	.50	4.00	.76	2074	172.8

GRAY IRON

Possesses

Valuable Engineering Properties

Part VIII

ATTEMPTS to apply formulas for evaluation of undetermined properties of gray iron from known factors constitute a fascinating pastime for the inquisitive foundryman or metallurgist. If such work is undertaken with a clear knowledge of its limitations, it quite likely may prove profitable and illuminating. However, it must be realized that all the variables in gray iron metallurgy cannot be encompassed within the scope of a simple and exact mathematical formula. At the present writing metallurgy of gray iron is more a scientific art than exact science. Years will elapse before the pioneers of gray iron have the field completely charted.

Aside from the question of individual design, its effects on contraction, feeding, internal stresses, etc., there are four major factors which determine the properties of gray iron to a great extent. These, which were explained more in detail in Part III on classification, are: Chemical composition (initial, incidental and final); physical and structural makeup of charge; temperature and atmospheric conditions encountered during melting process to moment of ingress in mold, and cooling rate from pouring time to room temperature or thereabouts.

Most of the formulas that have been advanced take into account only the first factor listed, namely chemical composition. The memorable studies of Turner on silicon and Howe on carbon in gray iron first called attention to the effects of these elements. After all gray iron is an iron-carbon alloy containing graphite flakes, ferrite, and pearlite, with smaller amounts of sometimes important structural components. The strength of a piece of gray iron is inversely proportional to the amount and size of graphitic carbon. It furthermore is dependent on the distribution of the graphite, the grain size, and on the relative amounts, distribution, and character of pearlite and ferrite as well as freedom from incipient shrinkage.

Obviously, the greater the percentage of total carbon, the greater the amount or volume of graphite flakes if (a) graphitization is complete or (b) if the combined carbon is approximately constant. This first was shown clearly by Prof. Howe as indicated in Fig. 50. The researches of Turner and of Keep showed that the strength of many irons varies inversely with the silicon content. Silicon is an accelerator of graphitization. In an iron of given carbon content and cooling rate, an increase in silicon generally means an increase in proportion of graphite and decrease in strength. Other common elements promoting graphitization are nickel and aluminum.

The effects of the former have been quite extensively studied, whereas the latter has not received a great amount of attention from a practical viewpoint. The graphitizing power of nickel is about half that of silicon, percentages by weight, and of itself nickel is said not to promote graphitization of the pearlitic cementite, that is to say, it confines its influence to primary cementite. Silicon, on the other hand, promotes decomposition of all

Explains Limits

FROM time to time various investigators have advocated the employment of formulas involving the summation of silicon plus carbon or some variation of that summation to predict the properties of gray iron. However, too many variable factors such as cooling conditions, etc., enter in to allow such a simple procedure. The limitations of applying such formulas are explained in this article which is the seventh of a series on the engineering properties of gray iron. The sixth of the series appeared in the July 1 issue.

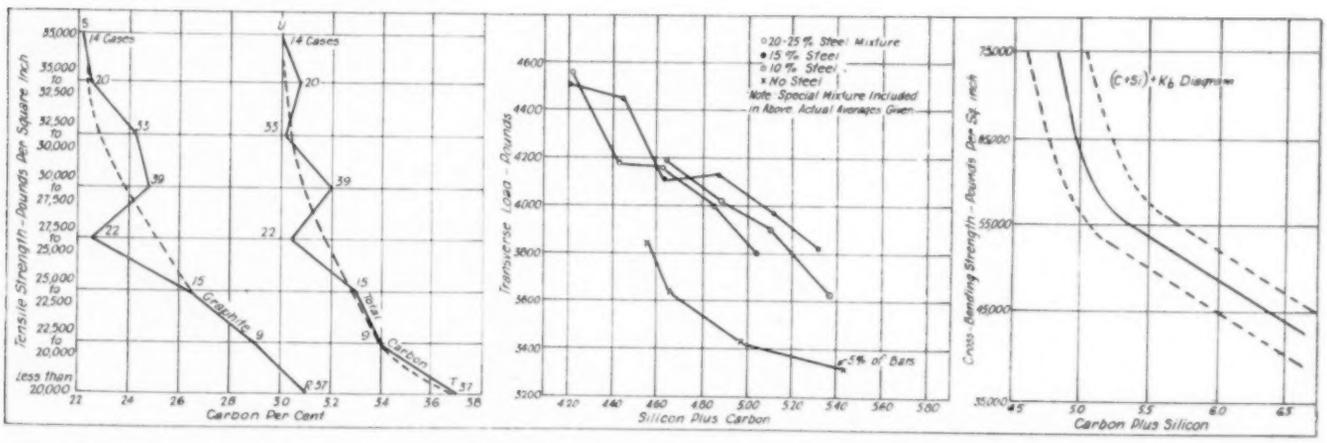
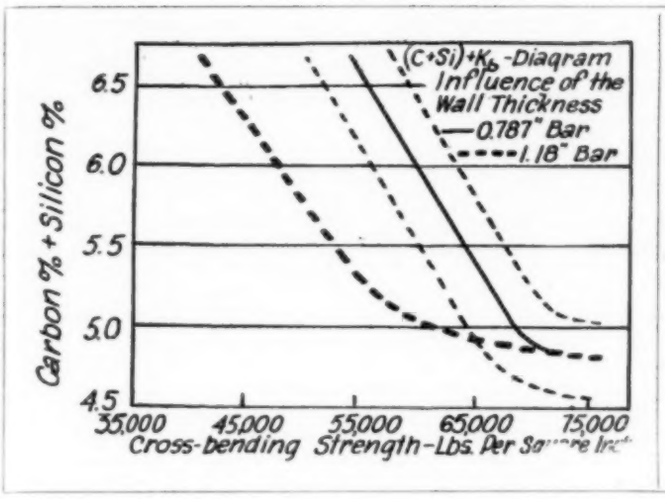


Fig. 50—Strength of Cast Iron Increases as Its Composition Approaches That of Steel. Fig. 51—Averages of Transverse Strengths on Specimens Containing Varying Amounts of Steel Scrap in the Charge. Fig. 52—Klingenstein's Study of 2000 Tests in an Esslingen Foundry



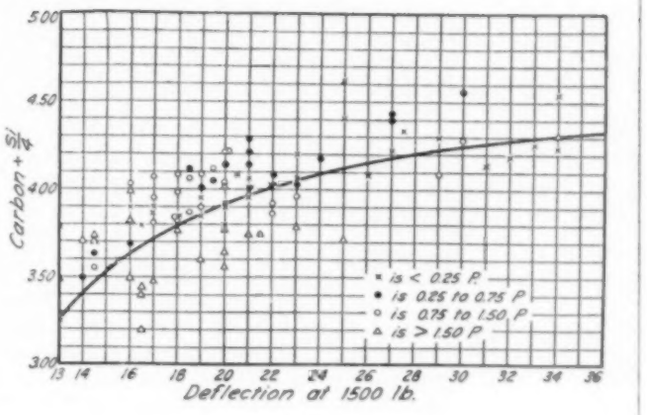


Fig. 53—Klingenstein's Results Obtained From Two Different Sizes of Bars. Fig. 54—MacKenzie's Curve Showing Relation Between Deflection and the Sum, Carbon Plus One-fourth the Silicon

cementite forms to graphite and ferrite. In addition to this silicon lowers the eutectic percentage (which is 4.3 per cent carbon, approximately, with no silicon present) about 0.30 per cent for each 1 per cent silicon. For example, the eutectic of a 2.50 per cent silicon iron is assumed to be about 3.55 per cent carbon. However, in actual practice it appears to be somewhat lower.

Consequently it is not surprising that the most common formulas deal with the percentages of silicon and of carbon. One of those advocated by some German metallurgists is as follows:

$$Sc = \frac{C}{4.26 - \frac{Si}{3.6}}$$

Where Sc = a constant for each type work; C = total carbon; 4.26 = iron-carbon eutectic, and Si = per cent silicon.

The precise interpretation of the 3.6 is unknown. Probably it has reference to the reduction of the eutectic some 1 per cent carbon for each 3.6 per cent silicon. If such is the case then the denominator is equivalent to the theoretical eutectic percentage given for a definite silicon percentage, and the formula becomes:

$$\frac{\text{Actual total carbon}}{\text{Theoretical eutectic}} = \text{a constant}$$

Values of Sc given are:

General castings — 0.9 to 1.0 (eutectic alloy).

Locomotive cylinders — 0.8 to 0.9 (slightly hypo-eutectic).

Rolls (presumably hard iron or chilled) — 0.75 to 0.83 (decidedly hypo-eutectic).

The application of such a formula is so vague that it does not mean much in a practical way. It indicates roughly whether the iron is eutectic or hypo-eutectic, and the constant could be obtained by analyses of gray irons which might be widely variant in physical properties. Of course, it is at fault in that it does not take into account cooling rate and other variables. This fault is common to all formulas computed from chemical analysis only.

Ledebur (Das Roheisen) used the following formula:

$$\text{T. C.} + \frac{Si}{1.5} = 4.2 \text{ to } 4.4$$

This formula obviously is similar in character to and possesses the defects of the first mentioned. J. E. Fletcher in the *Foundry Trade Journal*, July 28, 1927, advocates the use of the ratio:

$$\frac{Si}{\text{T. C.} + Si}$$

in comparison of various grades of iron, and shows some of the shortcomings of the simple Si + T.C. summation—particularly when wide variations in total carbon content are encountered.

The simple Si + C summation relation to tensile and transverse strength was studied by Bolton in the *Transactions* of the American Foundrymen's association, Vol. 33, 1924. Tests were conducted on about 1000 routine bars 1.25 x 15 inches containing 25, 15, 10 per cent and no steel scrap additions. Total carbons varied from 3.10 to 3.75 per cent and the silicon from 1.10 to 2.25 per cent. These bars were grouped according to the Si + C percentages and strengths of each group averaged. While insufficient detailed data is given for analyses by others it is known that for any given Si + C sum, the variations in strength of

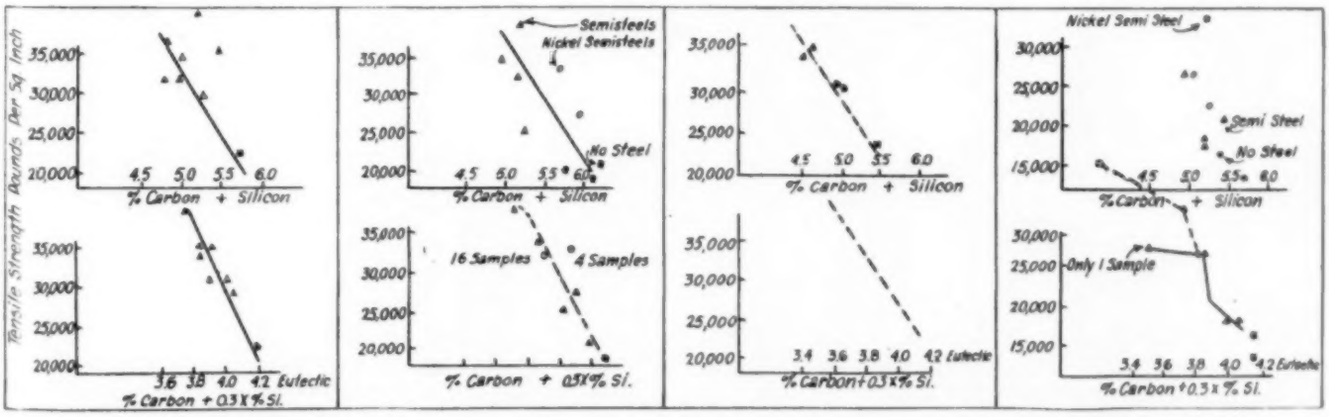
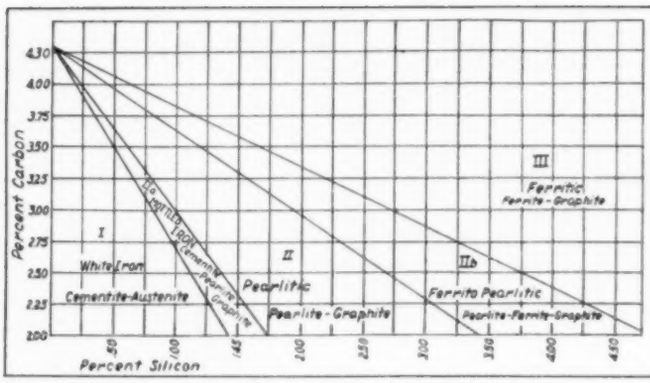


Fig. 55—A, Tensile Strength In Relation to Silicon Plus Carbon on 1-inch Bar. B, Tensile Strength In Relation to Silicon Plus Carbon on 1.2-inch Bar. C, Tensile Strength In Relation to Silicon Plus Carbon on 1.25-inch Bar, and D, Tensile Strength In Relation to Silicon Plus Carbon on a 2-inch Bar



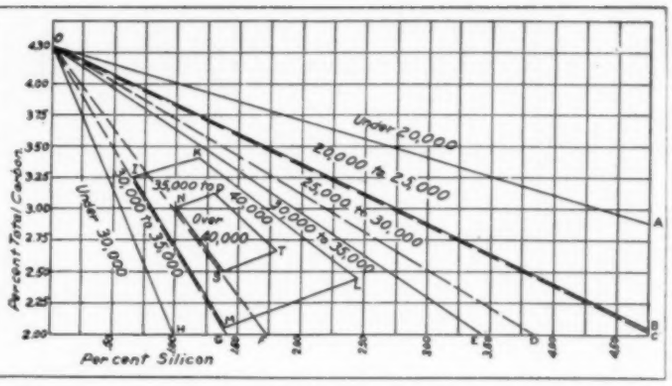


Fig. 56—Constitutional Diagram of Cast Iron According to Maurer. Fig. 57—Constitutional and Tensile Strength Diagram of Cast Iron From Data by Coyle Superimposed on Maurer's Diagram

individual bars were considerable.

This is hidden in the averages, that is to say, the law of averages smooths out most of the ordinary variations in day to day foundry practice under the same cupola and molding practice. The curves based on the averages are shown in Fig. 51. A definite trend is manifest, but variations are too great for use of the ratio as a precise indicator. For example at the point Si + C = 4.90, transverse strength (load) varied from 3600 to 4100 pounds. In spite of this the preliminary conclusions advanced at that time—"This sum gives a more accurate idea of the probable strength of the arbitration test bars than any other simple and inexpensive (indirect) test"—had some justification.

More recently Klingenstein in *Die Giesserei*, 1926, employed the Si + C summation in an extended study of some 2000 test results obtained in a foundry at Esslingen. The diameter of the test pieces was 30 millimeters (1.18 inches) and composition was within the limits silicon 1.2 and 3.2 per cent, manganese 0.6 to 0.8 per cent, phosphorus 0.3 to 0.6 per cent, sulphur 0.08 to 0.12 per cent and carbon 3.0 to 3.5 per cent. Relation of the Si + C summation to the cross-bending strength is shown in the curves illustrated in Fig. 52.

The bend in the curve at about 5.2=Si+C is due to the gradual disappearance of the ferrite. It should be pointed out that the average curve as prepared by the German investigators does not follow their data (dots) and contains a fallacy in that it indicated that strength at 4.5 = Si + C approaches infinity, a misleading indication. In Fig. 53 Klingenstein shows test results from two sizes of bars, the 20 millimeter and 30 millimeter (0.79 and 1.18 inch) bars. His results indicate that as both bars approach a pearlitic matrix strengths tend to coincide.

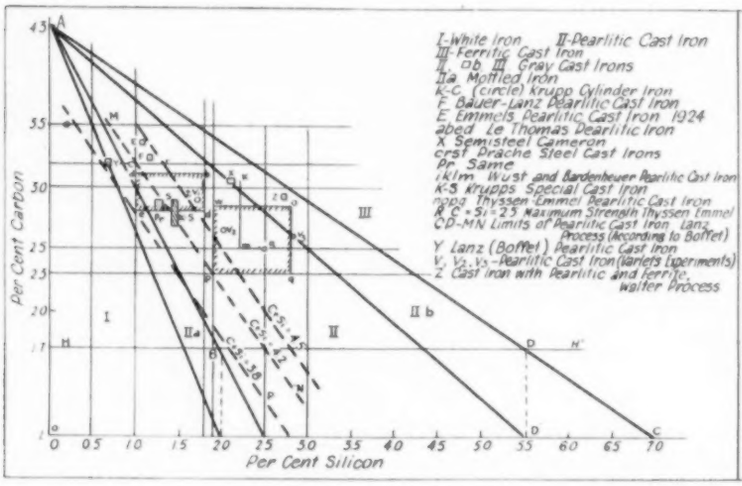
Carrying this analogy somewhat farther, the gap between the two curves at the maximum Si + C sum indicates that graphitization was not complete in the smaller bar, and that on more careful comparisons the effects of grain size should be considered. At the point of thermodynamic equilibrium the strength of gray iron is closely proportional to total carbon content.

Experience of various investigators soon indicated that the effects of silicon and carbon are not equivalent. Under like cooling conditions it sometimes appears that the effect of carbon is more pronounced than that of silicon. An early investigation along this line is that by MacKenzie presented in the *Proceedings* of the American Society for Testing Materials, 1924, and in the *Transactions* of the American Foundrymen's association, 1925. He showed that on the 2 x 1 x 24 inch pipe bar the deflections at a load of 1500 pounds are approximately proportional to:

$$\left(\frac{\text{carbon}+\text{silicon}}{4}\right)$$

In the latter paper MacKenzie showed that this deflection at the intermediate (1500 pound) load is more dependent on this sum than on phosphorus content. However, as pointed out by Bolton in a discussion of the latter paper, when silicon and carbon are approximately constant, the deflection at ultimate load is inversely related to the percentage phosphorus. MacKenzie's original curve is shown in Fig. 54.

In 1928 Bolton, in the *Transactions* of the American Foundrymen's association, vol. 36, pointed out that the relative position of an alloy in the composition co-ordinate of the iron-carbon diagram could be defined approximately by the sum (percentage total carbon plus 0.30 times the percentage of silicon). This in turn rests on the work of Wust, who showed that the eutectic is displaced


Per Cent Carbon
Per Cent Silicon
I-White Iron II-Pearlitic Cast Iron
III-Ferritic Cast Iron
I, IIb, III Gray Cast Irons
IIa Mottled Iron
K-C (circle) Krupp Cylinder Iron
F Bauer-Lanz Pearlitic Cast Iron
E Emmels Pearlitic Cast Iron 1924
abed Le Thomas Pearlitic Iron
X Semisteel Cameron
crst Prache Steel Cast Irons
Pr Same
Kirm Wust and Bardenheuer Pearlitic Cast Iron
K-S Krupps Special Cast Iron
1909 Thyssen-Emmel Pearlitic Cast Iron
R C+Si=2.5 Maximum Strength Thyssen Emmel
CD-MN Limits of Pearlitic Cast Iron Lanz Process (According to Boffet)
Y Lanz (Boffet) Pearlitic Cast Iron
V, V2, V3 - Pearlitic Cast Iron (Variefs Experiments)
Z Cast iron with Pearlitic and ferritic, Walter Process

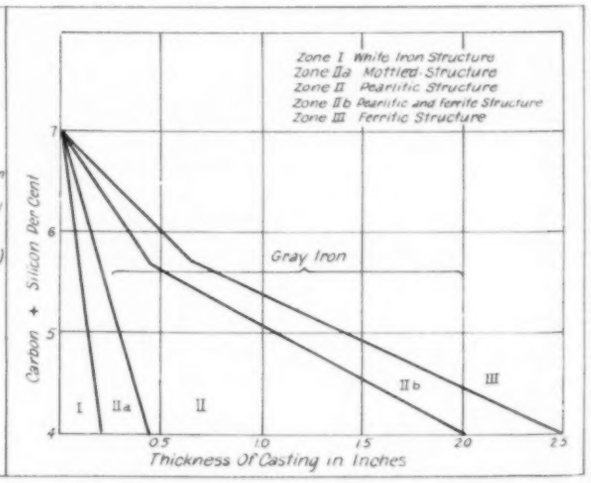

Zone I White Iron Structure
Zone IIa Mottled Structure
Zone II Pearlitic Structure
Zone IIb Pearlitic and ferrite Structure
Zone III Ferritic Structure
Gray Iron
Carbon + Silicon Per Cent
Thickness Of Casting in Inches

Fig. 58—Piedboeuf's Diagram Showing Positions of Cast Irons Produced by Various Continental Processes Superimposed on Maurer's Diagram. Fig. 59—Greiner and Klingenstein's Diagram Showing Relation Between Section Thickness and Silicon Plus Carbon

about 0.30 per cent for each 1.0 per cent silicon. Several curves taken from this work and shown in Fig. 55 indicate that plotting tensile strength against the sum (percentage carbon plus 0.30 times the per centage silicon) gives more concordant results than by plotting tensile strength against the sum (percentage carbon plus the percentage silicon). This appears to be particularly evident on bars other than the 1.25-inch and 1.20-inch diameter type.

In 1924 Maurer in the *Kruppsche Monatscheft*, 5-115, published a diagram shown in Fig. 56 indicating relationship of the structure of the gray iron to its carbon and silicon contents. This work was based on irons cooled at a constant rate. A later paper by E. Maurer and P. Holthaussen in *Stahl und Eisen*, 1927, indicates the influence of other cooling rates. As seen in Fig. 56, Maurer starts with iron of eutectic composition (4.3 per cent carbon and no silicon) which has an entirely white fracture. Proceeding to the right along the line 4.25 per cent carbon it is shown that some graphite is present with only small percentage of silicon content.

From about 0.50 to 1.60 per cent silicon the fracture is mottled. From 0.60 to 1.20 per cent silicon it has pearlitic matrix. From 1.20 to 1.65 per cent it has a ferrite and pearlite matrix while above 1.65 per cent silicon it has practically an all ferrite matrix. Incidentally, 1.65 per cent cilicon undoubtedly is too low to produce an entirely ferritic matrix in bars of this size made with American irons. It is noteworthy that as the percentage of carbon decreases the effect of silicon on the structure becomes less.

In the area II the structure is pearlite and graphite. Obviously a pearlite iron with 3.50 per cent carbon contains more graphite hence is lower in strength than a pearlitic iron containing 2.50 per cent carbon. This is indicated in the diagram shown in Fig. 57, by F. B. Coyle.

Piedboeuf in the *Foundry Trade Journal*, June 24, 1926, superimposed the positions occupied by materials, made by certain well known continental processes, on Maurer's diagram as shown in Fig. 58. In 1926 Greiner and Klingenstein evolved a diagram shown in Fig. 59, wherein the thickness of the casting in inches was plotted against the sum of silicon plus carbon. Referring to this diagram, area III, containing all ferrite and graphite, no hesitancy is made in pointing out the inexactness of this diagram. For example, the diagram would indicate that at 3 per cent carbon and 1 per cent silicon all sections above 2.5 inches are entirely ferritic matrix—which is far from true.

Win A. F. A. Apprentice Contests

TO SHOW its appreciation of the work being done by the Milwaukee Vocational school, the board of directors of the American Foundrymen's association at the Milwaukee convention in 1924 offered prizes totaling $45 for a molding contest in the iron foundry of the institution. That was the initial competition in gray iron molding which now is conducted annually under direction of the sub-committee on apprentice contests of the A. F. A. Scope of the contests also has been broadened and now in addition to previously mentioned prizes, awards also are given in steel molding and patternmaking. Regional contests are held throughout the United States and Canada and winners of final prizes are judged at the convention of the society.

Below are shown the winners of this year's contests. They are from left to right: Top row, Everett Field, Rock Island Plow Co., Rock Island, Ill., third prize, gray iron molding, Ralph Adams, Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa., third prize, steel molding; Clarence Janes, Hubbard Steel Foundry Co., East Chicago, Ind., second prize, steel molding; Leon Dionne, American Manganese Steel Co., Chicago Heights, Ill., third prize, patternmaking; Charles Deak Jr., American Steel Foundries, East Chicago, Ind., second prize, patternmaking; Bottom row, Moroni Heap, Brown & Sharpe Mfg. Co., Providence, R. I., first prize, gray iron molding; William Fielding, General Electric Co., Lynn, Mass., second prize, gray iron molding; William Norton, Hubbard Steel Foundry Co., East Chicago, Ind., first prize, steel molding; Peter Walzer, General Electric Co., Lynn, Mass., first prize, patternmaking.

Bill Tells of Molding a Smokestack-II

By Pat Dwyer

AFTER Bill left the other night I settled myself in the porch swing for a final smoke in peace and comfort with no one to bother me or to warn me not to fall asleep and then come creeping in later like a burglar. The official warner had departed some days before for the old home town. Before she flew away she left implicit instructions regarding the care of the flowers, the canary bird, the lights, the gas and particularly the importance of locking the doors and windows at a reasonable hour.

She is firmly convinced that large numbers of disreputable characters constantly prowl around by night trying doors and windows, with sinister design on the lives and property of the inhabitants. The fact that none of these frowsy marauders ever has been reported in our quiet neighborhood is dismissed with the statement that you never can tell. They probably are waiting for a good chance, meanin'—as the old West boys had it—when the shepherd is off duty.

On more than one occasion I have attempted to point out that she is doing the burgling fraternity a grave injustice. She is underrating their intelligence. "Put yourself in the place of one of these gentlemen." I have said, persuasively, "Just imagine you are a journeyman burglar in good standing in—say—Local 137 International Brotherhood of Burglars and Yeggmen—how long do you suppose you would be allowed to carry a card if the word reached headquarters that you wasted your time around dumps like this? Why, you would be laughed out of the organization. Your card would be annulled and you probably would have a stiff fine clapped on to you. I freely grant that at one time, burgling was more or less a hit or miss proposition with the individual burglar acting on his own initiative. Few or none of them had the advantage of a college training and as a result most of them easily were caught and almost as easily convicted. In recent years, with higher education within the reach of all, the modern burglar plans his work as carefully as his contemporary brother in more legitimate business enterprises. Only rarely is he caught and still more rarely is he convicted. If he cannot wiggle out of the scrape himself, an accommodating shyster lawyer—for a share in the loot—always is on hand to get him clear on a technicality."

I might just as well address this logical and closely reasoned argument to an Indian totem pole. Apparently the words pass in through one dainty ear and out through the other without touching a single responsive cell. She waits until I am through—sometimes—and then continues her monolog as if no interruption had occurred.

On this particular night the air was warm and oppressive. An occasional flash of lightning followed by a distant low rumble of thunder indicated that rain was not far off. According to all the rules and regulations duly made and provided for emergencies of this character, I should dash inside and close all the windows both upstairs and down.

The Warriors Throw a Scare Into the Victim

However, I reflected there was no hurry. The storm might not arrive for some time. Conceivably it might pass far to the south or to the north, over the lake and skip the city altogether. I have known of such instances. If I was silly enough to close all the windows and then discovered later it was not necessary, I would have the bother of opening them again. Dash it all, I was a free and independent citizen entitled to some rest after the gruelling activities of the day. Why should I spend the entire night running up and down stairs, opening and closing windows? Clearly, this was a situation that required some serious thought. I stretched myself out on the swing to debate the question mentally in all its various angles. Also to reflect luxuriously that I did not have to arise until I felt good and ready or until and if, the rain did come.

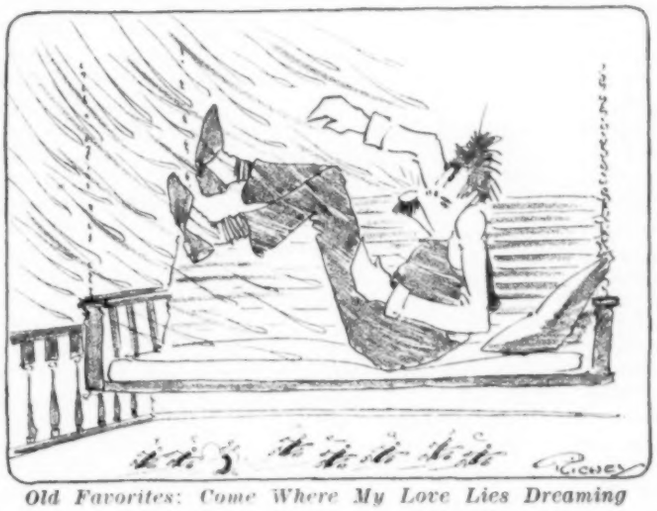
Association of ideas carried my mind back over time and space to the little town where I grew up and where—so far as I was concerned—windows did not exist. Probably some one opened and closed them, but I have no recollection of ever touching any of them. I occupied a place at the table for a brief period morning and evening and I slept in the house for a few hours every night, but on none of these occasions was I interested in the condition of the windows.

From the windows, my mind hopped to various camps we had built in the woods, some, flimsy structures of spruce boughs interlaced and supported on a framework of small trees growing around an approximate 6-foot circle. Others of a more substantial character in which the ground first was excavated to a depth of 2 or 3 feet and where the superstructure was composed of logs, notched and matched at the corners. Theoretically this type of cabin was perfect, but in actual practice it presented one serious flaw. As with the near beer verdict in which the judge and jury—all combined in the person of a gent who had seen better days—said; "It looks like beer, it smells like beer,

it even tastes like beer, but when its down, it ain't got the authority." So in this instance, the old log cabin in the bush looked all right, felt all right, kept out the sun and the dew, but practically was a total loss after every rain storm.

The walls did not leak, the roof did not leak. The only theory I can offer for the flooded floor is based on the old natural law that water always seeks its own level. Apparently the water in all the surrounding territory just naturally seeped through the ground until it found the old log cabin in the dell and then it poured in until the overflow poured out again through the doorway.

After a few of these experiences, we abandoned this type of architecture and built a club house high in the branches of three adjoining pine trees. This shanty marked the pinnacle of our building activities and incidentally set a mark for the grubby young cubs who followed us, to shoot at. During the summer we accupied it, half our time was spent in (a) preventing these upstarts from sneaking in to it and (b) in evicting them when we found them in residence. The shock of catching them in possession, making free with the sacred lares and penates, was not without its compensating features. First we had the exquisite pleasure of stunting their growth permanently by grabbing them by the legs and arms and threatening to throw them into space. One or two preliminary swings usually reduced the victim to a state of the most abject and gratifying humility. Please let him go this time and he'd never, no never, set foot in our part of the woods again.



Old Favorites: Come Where My Love Lies Dreaming

Knowing from personal experience the innate perfidy of the small boy, the—the—dash it all, the shocking readiness he displays in breaking the most sacred promises, promises, mark you, given freely and voluntarily, we carried each victim to the ground and tied him securely to a tree. Then we sat in solemn council and earnestly debated the relative merits of shooting him full of arrows, or of making him the center piece in a bonfire.

The witty member of the party always vetoed the bonfire idea. He claimed the kid was too green to burn. As an amendment to the motion he would spread-eagle the victim on the Council Rock until the fall. Then, he claimed, bone dry and sun cured, the lad would make a center piece as you might call a center piece, for a real fire, yea verily, a Hallowe'en fire!

Ah, well. All that was far away and long ago. Lying there on the swing the other night I wondered idly how this atavistic instinct for inflicting cruelty on those weaker than ourselves has persisted down through the ages. I suppose it has something to do with the general theory of the survival of the fittest. Savage tribes practice cruel rites on the theory that suffering is a necessary part of the education of a warrior. Civilization frowns on the practice publicly and officially, but it is winked at privately from the kindergarten to the highest halls of learning where freshmen are crippled for the glory of old alma mater.

Drifting idly from one line of thought to another, I wondered if any of the few remaining members of the old gang, ever sneaks away for a day to the quiet and peace of a sweet little brook on the outskirts of the town where in the halycon days, shiny, slippery, gorgeously spotted trout waited patiently to be caught.

Near the center of a wide meadow, a group of lordly elm trees furnished grateful shade on the south side of the stream. On more than one occasion the wide spreading branches sheltered us from the torrential downpour of a sudden summer storm. We watched the lightning flashes and quarreled violently over the distance as indicated by the elapsed time between seeing the flash and hearing the accompanying roll of thunder.

The beneficent providence which tempers the wind to the shorn lamb and—according to a popular belief—watches in a special manner over fools, children and drunks, kept us in blissful ignorance of our proximity to electrocution at any moment. The uppermost idea in our minds as indeed it would be uppermost in the mind of any true fisherman—was that the riled condition of the water ruined any further fishing, at least for the remainder of that day.

This was a theory to which I always had subscribed, but which I never had actually put to the test. Therefore when I suddenly found myself standing in the shelter of the elm trees, watching the lightning, listening to the thunder and waiting for the rain to cease, I decided to cast a worm into the water and settle this question for all time to my own personal satisfaction.

Fortunately the rod was in my hands. I readily extracted a worm from the can in my coat pocket, affixed it to the hook, cast the hook into the center of the stream and waited. Apparently the grandfather of all the trout that ever lived in the brook snatched the hook and attempted to pull hook, line and rod away from me. I pulled and the fish pulled and then I realized that unless the line parted I was due for a bath in the muddy stream and that probably the voracious monster on the other end of the line would nip at least one and maybe both legs short off above the knees before I could scramble out of the water. Throwing the last ounce of strength into the struggle, I slipped and fell into the stream and felt the shock of the cold water on my bare feet and legs. I saw the commotion kicked up by the animated torpedo as he rushed toward me with mouth wide open, breathing fire and smoke and roaring like a racing automobile with the cutout wide open. With a startled yelp I came to myself still stretched on the swing, with the last burst of thunder still growling overhead and with the rain beating down in a torrent on my exposed feet and legs, up to the knees.

I have not made my report on the subject. If the stains do not show, I shall not make any report, but it is a matter of considerable private self congratulation to reflect that probably never before were the windows closed so rapidly. Certainly I never expect to see them closed so rapidly again.

When I mentioned the incident to Bill he claimed I only had myself to blame for all the extra work. "When my Missus goes away," he boasted, "I shut all the windows and they never are opened again until she returns. Simplicity, my boy, simplicity is what does the trick and reduces all kind of work to a minimum.

"Of course limiting circumstances sometimes cramp a man's style, but usually several methods are available for doing any kind of work. Consider that cast iron smokestack I was telling you about the last time I was here. In the second method, the mold is formed almost entirely in green sand. The method carries a certain element of risk, but with a good grade of sand and with proper precautions, it is fairly satisfactory. The principal objection is that the mold

cannot be inspected before the metal is poured into it. The method involves a minimum of patternmaking and molding expense. Neither the cheek nor the inside have to be lifted and in that way no risk is involved of changing the thickness of metal in the mold.

"Practically the only risk involved is that of getting some loose sand in the bottom of the mold, or of having the metal cut the inside or outside face of the mold in its descent. With a good grade of sand properly rammed, the latter contingency is rather remote particularly if the metal is introduced through a multiplicity of small gates.

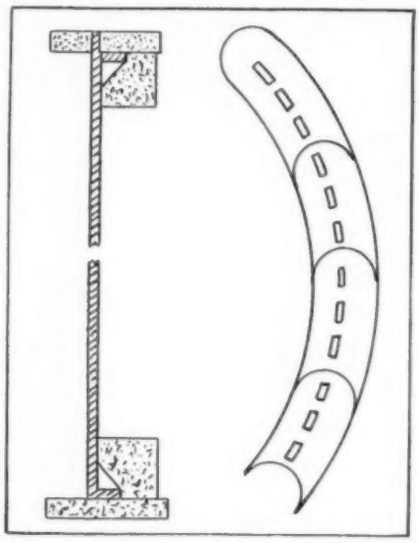
"The face of the mold cannot be blacked, but a clean surface on the casting will be assured by using facing sand against the pattern. This facing sand is made up of half and half new and old sand with one part of coal dust to 10 parts of sand. The internal flanges, top and bottom are formed in segmental dry sand cores, with a flat core under the face of the bottom flange and another flat core over the face of the top flange.

'The mold may be formed in a flask or in a pit in the floor. Each has its advantages and disadvantages and the method adopted will depend on shop custom and the available equipment. For example if no flask or curbing ring is available, the pit in the floor is the only alternative. It is easier to shovel and ram sand in a pit than in a flask, but on the other hand, with a close fitting flask, a much smaller amount of sand has to be handled. A space 4 to 6 inches is sufficient between the pattern and the flask, but a space of approximately 2 feet is required outside the pattern in a pit, to give the molder room to walk around while ramming the sand. Space in the inside of the pattern, whether in a flask or in a pit may be conserved by erecting a stack of 4-foot diameter flasks in the center. A roughly constructed wood drum may be utilized for the same purpose.

"Assuming that the mold is made in a pit in the floor, a level bed is made in the bottom either with a spindle and sweep, or with a pair of straightedges 7 feet in length and spaced 7 feet apart. Sand in this bed is rammed firmly and struck off flush. The straightedges may be left in place until all the castings are made. Pieces of straight rails are more satisfactory than wood straightedges on long running jobs.

"A short stake is driven down flush with the sand bed in the center to support one point of a pair of trammels. The other point is set to a radius of 38 inches and a circle is scribed on the bed to serve as an approximate guide in setting a ring of plain flat cores. These cores support the pattern and also form the lower face of the bottom flange on the proposed casting. The ring pattern, 12 to 15 inches high, ½-inch thick is placed on this ring of cores. The pattern ring may be wood or iron. A wood pattern must be handled with extreme care and may be reinforced on the top side by a number of substantial radial braces. Even a cast iron ring almost 6 feet in diameter and only ½-inch thick must be watched carefully to prevent distortion.

"After it is placed in position, two pieces of 2 x 4 scantling, cut to the exact diameter of the pattern, are inserted in the inside in the form of a cross. These will hold the pattern ring in a true circle while sand is



Left—Section of Assembled Mold. Right—Plan of Cover Cores

rammed on the outside. They only are required for the first setting of the pattern, but they may be used again near the top to insure accuracy.

"When the pattern is not in use it should be kept in a horizontal position. A pattern of this kind, stored vertically on the floor or suspended from a bracket, will spring out of shape to a considerable extent. This is a feature frequently overlooked by men who are not familiar with patterns of this kind. These patterns should be checked for diametrical accuracy each time before they are used.

"After the sand has been rammed to the top of the pattern on the outside, a set of flange cores is adjusted on the inside at the bottom. One face of each core rests on the flat core supporting the pattern. A second face rests directly against the inside face of the pattern. Sand then is rammed to the top of the pattern on the inside. The pattern then is drawn 4 or 5 inches and sand is rammed around it. The process is repeated until the desired height is reached.

"Two straightedges or rails are laid across the top of the pit approximately 4 feet apart and adjusted in such a manner that when the top edge of the pattern finally touches them at four points, the molder is assured the height of the casting will be correct and that the top and bottom flanges will be parallel.

"Sand on the outside of the pattern is scraped off flush. The flange on the inside is formed either by a short segment of pattern bedded in repeatedly all around, or, by a set of flange cores similar to those used on the bottom. If a segment pattern is employed to form the flange in green sand, it is advisable to vent under the flange with a wire and thus prevent any boiling or bubbling of the metal when the mold is almost filled.

"The ring pattern then is removed and the open top of the mold is covered with a set of cake cores similar to those placed in the bottom, with the single exception that the top cores are pierced with gate openings ¼ x 2 inches and spaced about 5 inches apart.

"A short piece of pig iron is placed on each side of each cake core to serve as a weight and also as a backing for the sand forming the runner basin. A wood block 2 or 3 feet in length, 2 inches wide at the bottom and 6 inches wide at the top and conforming to the circle of the casting is placed over the gate openings in the cake cores. The sand is packed on both sides of the block with the hands and the block is moved around by successive stages until the circle is complete.

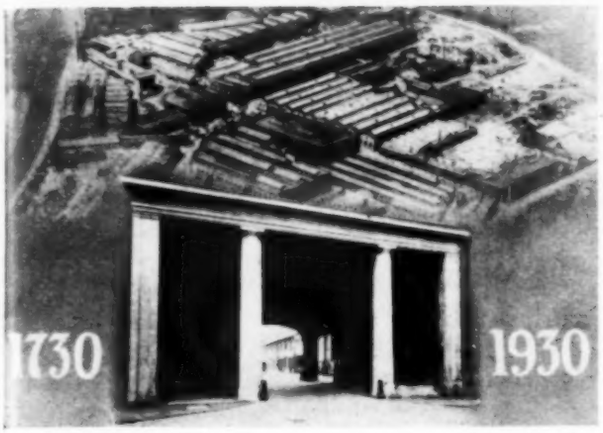
"Talking about the best way of doing things," Bill remarked, as he heaved himself to his long feet and prepared to depart, "reminds me of an exceedingly cute little story I read in a paper the other day. When I say cute, I mean cute. The doctor of a country village had two children who were acknowledged by the inhabitants as being the prettiest little girls in the district.

"While the children were out walking one day, they happened to pass two small boys; one a native son and the other a visitor. The visitor almost was stricken dumb, but he managed to whisper to his friend, 'Who are those beautiful little girls?'

"In a matter of fact tone, the local boy replied that they were the doctor's children. Then in deference to the city boy's ignorance he added: 'He always keeps the best for himself!' "

Opens New Office

Harnischfeger Corp. of Canada Ltd., recently established with headquarters at Ottawa, has opened an office at 504 Dominion Square building, Montreal, Quebec. L. P. Deephouse is district manager. The Harnischfeger Corp. of Canada Ltd. is the Canadian distributor for the line of overhead traveling cranes, hoists, etc., manufactured by the Harnischfeger Corp., Milwaukee.



Soho Foundry Celebrates 200th Anniversary

WHAT company can boast of having any more famous generals of the industrial revolution than James Watt, Matthew Boulton and William Murdock among its predecessors? Those men worked and invented revolutionary methods and equipment within the confines of the Soho Foundry, present headquarters of W. & T. Avery Ltd., Birmingham, England, which celebrated the bicentennial anniversary of its entrance into England's industrial development in July.

Soho Foundry began its existance as a button factory under the direction of Boulton and later developed into a jewelry and coin minting establishment. The advent of Watt and his invention of the steam engine made necessary the building of the foundry for the production of heavy castings required for that machinery. Soho Foundry was dedicated by Boulton in 1796 with great ceremony. Murdock, who was engaged by Boulton on the strength of his invention of a method for turning an oval piece on a lathe, invented and built some of the first pieces of machinery of their kind while employed in the foundry. Among them were the first gas container in the world, a steam carriage, the first bicycle and one of the earliest locomotives.

Combine of Old and New

Business of James Watt & Co., makers and repairers of steam plants, was conducted at Soho Foundry for nearly a century, from 1796 to 1895 when the foundry was purchased by the present owners and devoted to the production of weighing and testing machinery. The foundry is a strange mixture of the eighteenth, nineteenth and twentieth centuries. It is both a museum and a production unit making quality castings to fit accurate jigs.

When the foundry first was constructed, it consisted of two parallel bays, each 42 x 162 feet running east and west. Since that time additions have been made and the greatest length of the building now is 450 feet north and south. Heavy castings are made in the original bays and the extension houses the light floor and bench molding sections. Recent increases in orders have caused the contemplation of plans for a continuous casting plant.

Attempts have been made to standardize sand facings by use of automatic machinery but thus far those efforts have been unsuccessful because of the great variety of work made in the shop. Sand is prepared in a roller type mill and mixed in a disintegrator. Floor sand in the molding machine area is put through a portable blender. A large number of castings are made in green sand molds. Stourbridge sand is used in the molds and sea sand for cores.

Uses Many Mixtures

The daily melt in the shop does not exceed 140 tons generally and it is not uncommon to run as many as five different mixtures in a day. There are five cupolas in the shop two of which are charged mechanically and the remainder by hand. The latter group have capacities of 4 to 6 tons per hour and are equipped with forehearths. Cupolas are lined once a week with a mixture composed of equal parts of yellow ganister, coke dust, and spent sandblast sand. Since coke dust and sandblast sand are waste products, the cost of linings is reduced materially. Although gray iron and semisteel form the majority of the metal melted, castings also are made from brass, gunmetal, nickel alloys, aluminum alloys, etc.

Seventeen hydraulically operated molding machines are used in the foundry and in addition four assembling machines for flaskless work. Ample facilities are available for transportation of metal, molds, etc. and castings are cleaned with the aid of modern equipment.

As has been previously stated, the Soho Foundry may also be classed as a museum. Many pieces of machinery of historical nature may be seen such as the first gas container and the first cottage lighted with gas. Many underground passages and caverns built and used by James Watt for secreting his manufacturing processes are located under the foundry. The passages while of historical value, often are a source of trouble in the installation of new equipment and frequently necessitate heavier construction than would ordinarily be necessary.

In addition to the foundry, W. & T. Avery Ltd. maintains many buildings and departments for the manufacture of weighing machinery. The general offices of the company also are located there.

Book Review

Gmelins Handbuch der Anorganischen Chemie, Eisen, Teil B. Lieferung 1, paper, 312 pages, 6¾ x 10 inches, published by Verlag Chemie, Berlin, Germany, and supplied by THE FOUNDRY, Cleveland, for $12 plus 15 cents postage.

This is the third volume of the series of books relating to iron which is a part of Gmelin's work on inorganic chemistry. This book deals with the combinations of iron. The first topic on iron and the rare gases states that they do not diffuse through iron. The second discusses iron and hydrogen and includes data on iron hydride. The third topic covers iron and oxygen with divisions on the various types of oxides, such as iron suboxide, ferrous oxide, ferrosoferric oxide, ferric oxide, iron peroxide, etc. The fourth topic describes iron and nitrogen with divisions on the various combinations of iron and nitrogen, ammonia, etc. The fifth topic deals with iron and fluorine, and the sixth covers the numerous combinations of iron and chlorine.

Completes Laboratory

The United States Pipe & Foundry Co. is completing a 3-story laboratory to be devoted to all phases of research work in connection with the production of cast pipe. In particular, the building will be devoted to the study of foundry practice and the solution of problems in connection with iron, coke and sand in the production of castings. The new building, which is located along the company's headquarters at Burlington, N. J., is under the direction of Dr. F. C. Langenberg, director of research for the company.

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The Shakeout

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¶ Green Pastures a Mirage

WHEN business conditions are bad in one locality, often a migration of workmen takes place toward centers where greater activity is reported. The result many times is unpleasant to the migratory workmen. Instances of this fact are multiplied by the thousands where large public works are undertaken, where new operating oil wells are reported or where some purely local conditions produces an unusual building construction activity.

TO A lesser degree a similar tendency will be noted among foundry foremen and superintendents. The present business situation offers no high spots to induce this sort of general change of residence. In the automotive centers where foundry business has been exceptionally dull some few foundry executives have expressed a wish to remove to other centers not dependent upon America's gigantic, but temperamental automobile manufacture. No high spots are visible to attract men at present connected with automotive plants. Nevertheless the tendency is evident due to the discouraging state of automobile business. It is a safe bet that your own job is at any rate, no worse than the other fellow's during the present seasonal slump.

¶ Should Get Together

THE old mousetrap days of happy memory, when the excellence of a man's product induced a horde of eager customers to beat through the trackless wilderness a pathway to his door, are gone and in all probability, gone forever. Excellence of product still is an important sales factor, but in these modern days of keen competition, it is only one of many factors essential to the process of keeping a manufacturing plant running on a profitable basis. Up to the present—although many are qualified by experience—no one has presented a convincing reason for operating a plant, a factory or any business at a loss. That lets *that* factor out.

UNDER the present business system, a system that has been in process of development for many years, two factors have come to be recognized as equal to if not more important than excellence of the product. The first of these is an adequate cost system and the other is the membership in a group or association made up of people engaged in a common industry. The cost system, if it is employed as a working tool and not as an ornament will help to keep the business in a solvent condition. Membership in a trade group will confer benefits impossible of attainment by the individual.

CONSIDER one of many similar experiences of a brass founders association in the East. Hearing that a certain railroad company was contemplating the acceptance of a bid from outside the state for its annual brass castings requirements, the association sent a strong committee to interview the general manager and to protest against a policy inimical to the best interests of the district. As importers and exporters—in a definite territory—of bulk freight, they contributed materially to the revenue of the railroad. If they had no castings to make, this revenue automatically would cease. The G. M. never has been accused of defective eyesight. He can see into a grindstone as far as the next person. Which perhaps is one of the reasons why he is the G. M. The castings were made in local foundries.

¶ Spread the Work

A DEFINITE policy of spreading that work which is available to give employment to as many workmen as possible is being followed by a number of organizations during seasonal slack operations such as obtain this summer. One large automotive foundry with only 1500 cylinder castings on order, pending a change in model of one of its large customers, divided this work into ten parts. This gave part time employment for ten days to its force, which under ordinary conditions could have made the entire lot in a single day. The time may be further used to advantage to clean up shop, to give the windows that scouring which will increase their transparency under the fall skies, when business is better. Not a bad time, either, to check over equipment, make needed repairs and throw out those obsolete units which accurate cost figures will show to be cutting down production and wasting profits. Not a bad time, this, to revamp, revise and prepare for better times.

Comings and Goings of Foundrymen

Men of the Industry, Whose Activities Are Making Foundry History

FRED L. WOLF, head of the development engineering, technical and plant control departments, Ohio Brass Co., Mansfield, O., was elected a director of the American Foundrymen's association at a directors meeting of that society at Detroit, July 15 and 16. He succeeds L. W. Olson, factory manager, Ohio Brass Co., who resigned, after 10 years as director, vice president and president of the A. F. A. Mr. Wolf was born at Elmore, O., May 12, 1885. He was graduated from Toledo high school in 1904 and entered the University of Michigan from which he was graduated in 1908 with a B. S. degree in chemical engineering. He then entered the employ of the Detroit White Lead Works as chemist. He resigned that position a year later to become a chemical engineer at Cobalt, Ont. In 1911 he entered the employ of the Ohio Brass Co., Mansfield, O., as chemical engineer and later became manufacturing engineer. Mr. Wolf is a member of the American Foundrymen's association, American Society for Testing Materials, American Institute of Mining and Metallurgical Engineers, American Chemical society, American Society for Steel Treating, American Engineering Standards committee and British Institue of Metals.

John H. Mayworm, who since July 1 has been foundry superintendent for the Warman Steel Casting Co., Huntington Park, Cal., was general superintendent of the Wehr Steel Casting Co., Milwaukee, for the preceding twelve years.

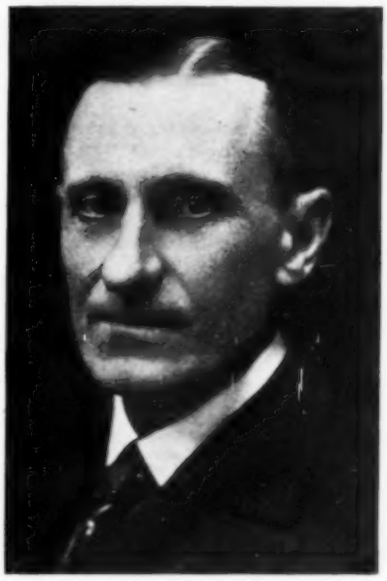
Harold P. Furlong, formerly connected with the Climax Molybdenum Co., New York., has become associated with the Wisconsin Gray Iron Foundry Co., Thirty-ninth avenue and Burnham street, Milwaukee. The company specializes in molybdenum alloy castings.

Joseph B. Meier has severed his connections with the F. &. H. Foundry Co., Inc., Newark, N. J. and will engage in the brass foundry business. The name of the new company will be known as the General Brass Foundry Co. Inc.

George H. Aupperl, formerly employed by the Tobatta Foundry Co., Tokyo, Japan, as consulting metallurgist, has resigned his position with that company and is returning to Pittsburgh. Before going to Japan, Mr. Aupperl was chief metallurgist, National Roll & Foundry Co., Avonmore, Pa.

H. M. Lewis who for the past 20 years has been affiliated with various steel, malleable and gray-iron foundries in the Buffalo district as manager and general superintendent, has organized the H. M. Lewis Co., 506 Jackson building, Buffalo. This company will act as sales representative handling foundry equipment, refractories and molding sands.

Dr. Fritz W. Meyer, for the past several years chief metallurgist of the National Radiator Corp., Johnstown, Pa., has resigned that position to open an office as general foundry consultant and metallurgist at 231 South LaSalle street, Chicago. He still retains a connection with the radiator corporation in a consulting capacity.



Fred L. Wolf

H. Zwicker, formerly connected with the Dayton Malleable Iron Co., Dayton, O., at its Canton, O., plant, has taken a position as foundry superintendent with the Acme Steel & Malleable Iron Works, Inc., Buffalo. Prior to his connection with the Dayton company, he was associated with the Grabler Mfg. Co., Cleveland, from 1910 to 1927. From 1919 to 1923 he served as foundry superintendent of that company. During the years 1928 and 1929 he was connected with Stanley G. Flagg & Co., Stowe, Pa.

Frederick A. Melmoth, technical director, Detroit Steel Casting Co., Detroit, has been made assistant manager. Prior to assuming his duties with the Detroit company on March 1, 1930, he was associated with Thomas Firth & Sons, Sheffield, Eng., for 4 years as foundry manager; Lake & Elliott Co., Braintree, Essex, from 1919 to 1926 as steel maker and foundry manager; and National Steam Car Co., Chelmsford, as foundry manager. Mr. Melmoth was born in Sheffield, Eng., and received his technical education at Sheffield university. In 1913 he was appointed an associate in metallurgy and was awarded the Mappin medal. He received his early training at Brown Baily Steel Works, Sheffield, where he served in the office, as assistant in the research laboratories, and as head of the night shift in the open-hearth department.

Ohio Foundrymen To Meet in August

The fourth sectional conference of the Ohio Foundries Association, Inc., will be held at Cincinnati Wednesday, August 13, according to Robert Hoierman, secretary, Cleveland. Samuel Herndon, traffic manager of the Cincinnati chamber of commerce, will address the board of directors at a meeting Tuesday night, August 12, and also will be a principal speaker at the general meeting Wednesday. The local committee in charge of arrangements for this meeting is announced as follows: General chairman, W. H. Geier, Cincinnati Milling Machine Co., foundry division; vice chairmen, Wm. Gilbert, Buckeye Foundry Co.; B. I. Kaufmann, Edna Brass Co.; Edwin B. Hausfeld, vice president, Ohio Pattern Works Co.; and E. L. Brooks, Sawbrook Steel Casting Co.; all of Cincinnati.

New England Founders To Hold Outing

New England Foundrymen's association will hold its annual August outing at the Pomham club, Providence, R. I., Aug. 13. Providence members of the association have charge of arrangements. C. E. Andrews, Whitehead Bros. Co., is chairman of the committee on arrangements and W. G. Rich, Providence Gas Co., is chairman of the committee on entertainment and sports.

Crawford Oven Co., New Haven, Conn., is building a new office and factory at 200 Shelton avenue. The first unit is a concrete, brick and steel, one-story plant, located on the company's siding from the New York, New Haven & Hartford railroad.

The Valve of the Rammer Is Sealed Against Air Leakage

Sand Rammer Has New Valve Design

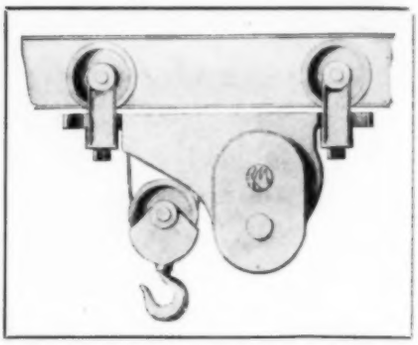
A new type of sand rammer shown in the accompanying illustration, recently has been designed and placed on the market by the Cleveland Pneumatic Tool Co., Cleveland. The new rammer is made in suitable sizes for the various classes of foundry ramming and has several new features.

The main valve of the new tool is pressure-seated at both ends. The effect of wear on the sidewalls of the valve is minimized, since the valve is sealed against air leakage at either end. Lubrication is provided by an automatic system consisting of an oil reservoir placed in the head of the rammer and which feeds automatically to all moving parts of the tool when running. The rammer is protected from dust by a specially designed packing gland placed in the front end of the rammer cylinder. The gland is unusually long with its outer and inner sides ground in alignment with the piston rod and bore of the cylinder, sealing against the entrance of grit or other foreign matter. The packing gland nut is locked in position automatically after each adjustment of the packing, and as the packing is kept saturated with lubricant the piston rod is oiled constantly. The cylinder of the rammer is made of an alloy steel admitting of deep-hardening of the walls of the cylinder bore. This feature permits several regrindings when the cylinder becomes worn in use.

New Hoist Is Small

The hoist and crane division of Robbins & Myers, Inc., Springfield, O., recently has introduced a bantam-size hoist, shown in the accompanying illustration and designed for either I-beam or monorail use.

Among the outstanding features of the hoist are its small size and light weight. Complete with trolley, the hoist weighs only 130 pounds and its overall dimensions are 18 x 24 x 14 inches. A capacity of 500-pounds and a speed of 30 feet per minute are provided. The motor, manufactured by the same company, is designed for full dust and moisture protection. Positive lubrication is provided.



Small Hoist Furnished for Either I-Beam or Monorail

The frame of the hoist is designed to permit the use of the standard I-beam trolley or any make of monorail trolley. Direct and alternating current styles are manufactured with either rope or push-button control. The new hoist serves a practical need in moving large quantities of light material where rapidity and economy

Foundry Association Directory

American Foundrymen's Association

President, N. K. PATCH, Lumen Bearing Co., Buffalo; executive secretary-treasurer, C. E. HOYT, 222 West Adams street, Chicago; technical secretary, R. E. KENNEDY, 222 West Adams street, Chicago.

Associated Brass Founders of New England

President, GEORGE W. THORNBURG, Crescent Park Brass Foundry, Waltham, Mass.; secretary, R. B. BONNER, Somerville Machine & Foundry Co., 14 Kent street, Somerville, Mass. Meeting the fourth Wednesday of each month at the Engineers' club, Boston.

The Buffalo Foundrymen

President, J. MCARTHUR, Washington Iron Works; secretary, W. J. WARK, E. J. Woodison Co., 140 Chandler street. Meetings each month at club rooms, 140 Chandler street.

Central Illinois Foundrymen's Club

President, H. M. HIRE, Hire Foundry Co., Peoria, Ill.; secretary, FRANKLIN WHITEHEAD, The Meadows Mfg. Co., Bloomington, Ill.

Chicago Foundrymen's Club

President, H. P. EVANS, Hubbard Steel Foundry Co., East Chicago, Ind.; secretary, ALBERT N. WALLIN, S. Obermayer Co., 2563 West Eighteenth street. Meetings first Thursday in each month at the City club, 315 Plymouth court.

Connecticut Foundrymen's Association

President, CARL S. NEUMANN, Union Mfg. Co., New Britain, Conn.; secretary, CHARLES S. PARKER, Charles Parker Co., Meriden, Conn. Meetings are on second Friday of each month in various parts of the state.

Detroit Foundrymen's Association

President, JAMES L. MAHON, American Car & Foundry Co.; secretary, WILLIAM J. MUHLITNER, Great Lakes Foundry Sand Co., 2100 Penobscot building, Detroit. Meetings third Thursday in each month, except December, June, July and August at Masonic temple.

East Bay Foundrymen's Association

Secretary O. R. MOLLER, Electric Steel Foundry Co. Inc., 1328 Second street, Berkeley, Calif.

Electric-Steel Founders' Research Group

Director, R. A. BULL, Assistant Director, C. N. RING; Central Office, 541 Diversey Parkway, Chicago.

Gray Iron Institute

President, WALTER L. SEELBACH, Forest City-Walworth Run Foundries Co., Cleveland; secretary, ARTHUR J. TUSCANY, Terminal Tower building, Cleveland.

Malleable Iron Research Institute

President, R. R. FAUNTLEROY, Moline Malleable Iron Co., St. Charles, Ill.; secretary, ROBERT E. BELT, Union Trust building, Cleveland.

Metropolitan Brass Founders' Association

President, WILLIAM EMBER, Jefferson Brass Foundry, 62 Delevan street, Brooklyn, N. Y.; secretary, WILLIAM E. PAULSON, Thomas Paulson & Son Inc., 97 Second avenue, Brooklyn, N. Y. Meeting second Wednesday in each month at the Building Trades club, 2 Park avenue, New York.

Newark Foundrymen's Association

President, W. H. MANTZ, Atlas Foundry Co., Irvington, N. J.; secretary, G. W. HANNAY, Barnett Foundry & Machine Co., Irvington, N. J. Meeting called by president.

New England Foundrymen's Association

President, ERNEST F. STOCKWELL, Barbour-Stockwell Co., Cambridge, Mass.; secretary FRED F. STOCKWELL, 205 Broadway, Cambridgeport, Mass. Meetings second Wednesday of each month at the Exchange club, Boston. Outings usually are held in the summer months.

Ohio Foundries Association Inc.

President, DON MCDANIEL, Hamilton Foundry & Machine Co., Hamilton, O.; secretary, ROBERT HOIERMAN, 418 Penton building, Cleveland.

Pacific Coast Founders Association

President, CHARLES J. P. HOEHN, Enterprise Foundry Co., 2902 Nineteenth street, San Francisco; manager, S. M. TRUITT, 55 New Montgomery street, San Francisco.

Philadelphia Foundrymen's Association

President, C. F. HOPKINS, Ajax Metal Co., Philadelphia; secretary, EARL SPARKS, 1623 Sansom street, Philadelphia. Meetings the second Wednesday of each month at the Manufacturers' club.

Pittsburgh Foundrymen's Association

President, W. E. TROUTMAN, Duquesne Steel Foundry Co., Pittsburgh; secretary-treasurer, WILLIAM J. BRANT, Wm. J. Brant, Bessemer building, Pittsburgh. Meeting on the third Monday of the month, except in July and August at Fort Pitt hotel.

Quad-City Foundrymen's Association

President, R. L. EICHMAN, Bettendorf Co., Bettendorf, Ia.; secretary-Treasurer, STANLEY BRAH. Meetings the third Monday of each month, the meeting place being rotated between Moline, Rock Island and Davenport.

St. Louis District Foundrymen's Club

President, HORACE R. CULLING, Carondelet Foundry Co., St. Louis; secretary-treasurer, LEO J. FILSTEAD, John C. Kupferle Foundry Co., St. Louis. Meeting the fourth Thursday of the month at 6:30 p. m., at the American Annex hotel, Sixth and Market streets, St. Louis.

Southern Metal Trades Association

President, JOHN S. SCHOFIELD, J. S. Schofield's Sons Co., Macon, Ga.; secretary, W. E. DUNN JR., Flatiron building, Atlanta, Ga.

Steel Castings Development Bureau

Research Director, GEORGE BATTY, 500 Stock Exchange building, Philadelphia.

Steel Founders' Society of America

President, J. E. MCCAULEY, Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.; managing director, G. P. ROGERS, Graybar building, New York. Meetings: Cleveland, May 12-15, 1930.

Tri-City Technical Council

Chairman, C. F. SCHERER, Davenport Machine & Foundry Co., Davenport, Iowa; secretary, E. C. XANDER, assistant secretary, Tri-City Manufacturers association, Moline, Ill. Combined meetings held only one or two times a year on call.

Tri-State Foundrymen's Association

President, WILLIAM HOPPENJANZ, The Star Foundry Co., 221 Main avenue, Covington, Ky.; secretary, C. C. ERHART, Chris Erhart Foundry Co., Cincinnati. Meetings the second Thursday of each month at the Cincinnati club, Eighth and Race streets.

Twin City Foundrymen's Association

President, WILLIAM J. SNYKER, St. Paul Foundry Co., St. Paul; secretary-treasurer, C. E. LANGDON, 3849 Lyndale avenue, south, Minneapolis. Meeting third Wednesday of each month at Athletic club.

Washington Foundrymen's Club

President, J. W. ORPHAN, Lake Union Foundry Co., 1703 Westlake avenue, Seattle; secretary, EDWARD C. GUSTIN, The Prescott Co., 1 West Lander street, Seattle. Meetings second and fourth Tuesdays of each month at the Elks Temple, Fourth avenue and Spring street.

Western Foundrymen's Association

President, H. T. HORNSBY, Joplin, Mo.; secretary, E. L. GRAHAM, Acme Foundry & Machine Co., Coffeyville, Kans.

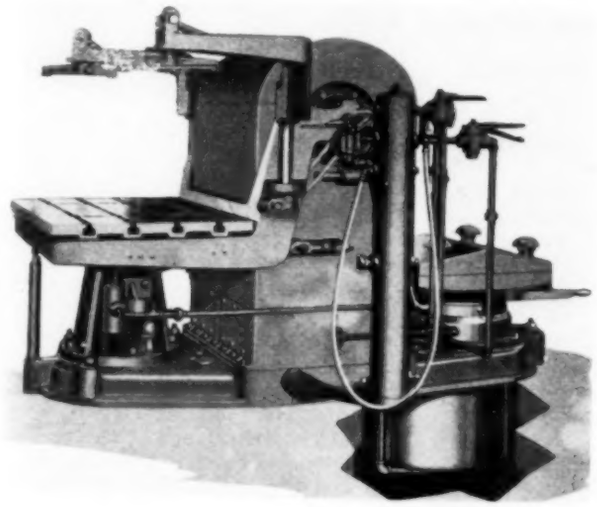
Wisconsin Gray Iron Foundry Group

Secretary, W. F. BORNFLETH, Cutler-Hammer Inc., Foundry Division, Milwaukee. Meetings on first Wednesday of each month at Hotel Schroeder, Milwaukee.

are necessary in connection with space limitations in the shop.

Dustproof Construction Features Machine

A new model rollover molding machine, shown in the accompanying illustration has been introduced by Milwaukee Foundry Equipment Co., Milwaukee. It is a power jolt, power rollover, power draw machine featuring a dustproof housing inclosing the entire rollover mechanism which is mounted on ball and roller bearings.



Rollover Parts Are Mounted on Ball and Roller Bearings

The machine has a rated capacity for rolling over a 1500-pound load, and is designed to prevent varying loads from stopping on dead center. The roller bearings on the trunnions are the same size as used in the rear wheels of a 7-ton truck. The bearing housings are similar in construction to standard automotive practice, and contain grease to last 6 months.

The draw is oil operated to provide a smooth, steady draw. The draw piston and guide rods are totally inclosed in a one-piece gray iron sleeve, machined over its entire outer surface. A long, jolt piston is provided, and the jolt base is of semi-steel and has a renewable sleeve. The pattern plate is cast steel. The rollover arm also is cast steel and the trunnions are alloy cast steel. The jolt, rollover and draw are separate assemblies and any one may be removed moving with the others.

The machine can be supplied with either hand or air operated flask clamps and gravity conveyor on the draw table. The leveling device or equalizer is controlled from the control column, and when used in connection with the air clamps, the operator need not leave his position at the control column from the time he starts to rollover the flask until the pattern is rolled back into position for the next mold.

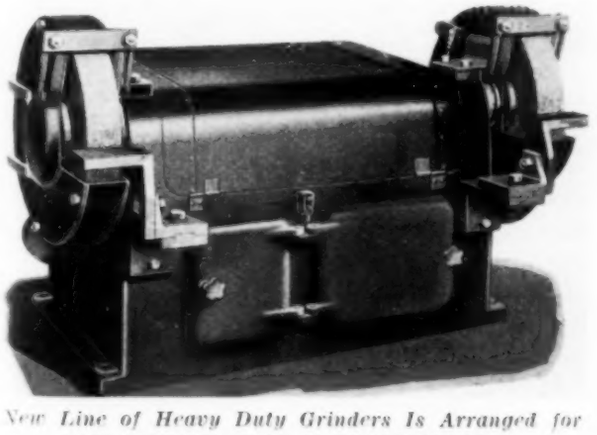
Guard Controls Speed Of New Grinders

Kling Bros. Engineering Works, Chicago, recently has introduced a new line of high speed, heavy duty grinders. The new grinder, shown in the accompanying illustration, is designed for rough grinding and snagging of castings. The machine incorporates several new features of design.

The wheel shaft is split and connected with a rigid, bolted coupling which can be removed for quick replacement of the V-belts when they become worn or damaged.

Another interesting feature is a safety device which prevents running wheels over recommended speeds. The device consists of a cam and lever movement actuated from the spark guard to the control arms located under the motor base. When the spark guards are lowered, due to wheel wear, the control arms also are lowered, permitting the motor base to slide forward, thereby making possible the mounting of the next size of sheave. The spark guards cannot be raised for mounting new wheels until the motor is brought back to the slow speed position.

The new line is made in three sizes, for 18 x 2-inch wheels, 24 x 3-inch wheels and 30 x 4-inch wheels, respectively. All three units are of the same general construction.



New Line of Heavy Duty Grinders Is Arranged for Quick Belt and Speed Sheave Change

Thermostat Is Control For Melting

A new quartz rod thermostat for controlling the temperature of soft metal melting pots for use with tin, babbitt, solder, etc., has been placed on the market by the General Electric Co., Schenectady, N. Y.

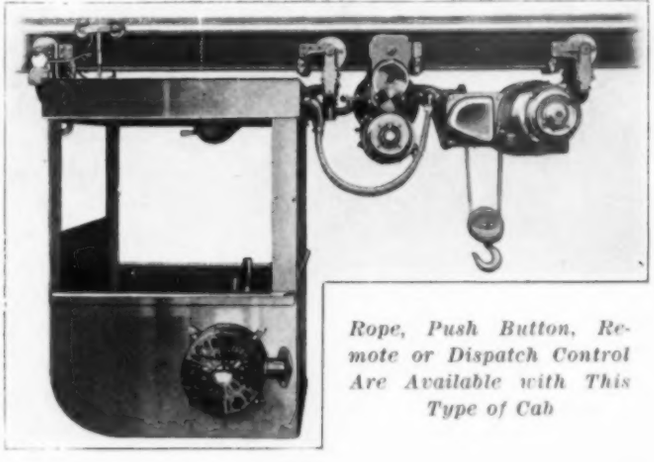
The thermostat consists of an enclosed switch and a nickel-chrome iron tube extending from its base and surrounding a steel piston and quartz rod.

The new thermostat has a temperature range of 450-950 degrees Fahr. and is designed to control temperatures to within plus or minus 14 degrees Fahr. of its setting. The contacts are designed to carry the current necessary to operate any standard automatic control panel.

Motor Driven Trolley Has Flexibility

A new motor-driven trolley, shown in the accompanying illustration, has been introduced by the Louden Machinery Co., Fairfield, Iowa. The equipment is designed for handling hot iron, sand molds, flasks, pigs, coke, castings and other foundry materials.

Control is available in rope, push-button, or remote or dispatch types permitting the trolley to be operated



Rope, Push Button, Remote or Dispatch Control Are Available with This Type of Cab

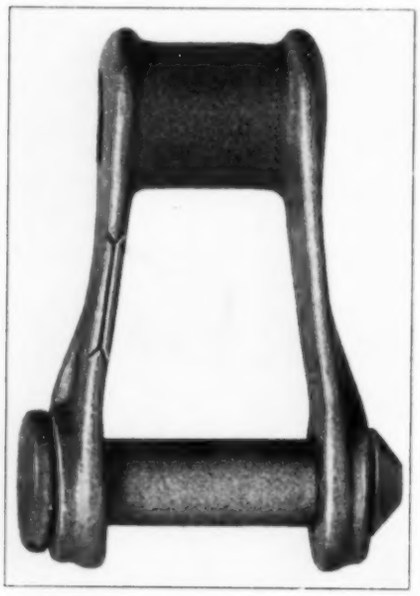
in the way best suited to the layout. The cab is open or closed and may be supplied with a step-on platform when the operator must frequently dismount.

The mechanical details given the trolley are designed to operate dependably under adverse conditions where dirt, dust, or foreign materials are constantly present. All gears are inclosed and moving parts that do not run in oil are reached by high-pressure lubrication. All rotating parts, including the motor, run on ball bearings. Hook capacity is furnished up to 4000 pounds.

Special Metal Used in Making Chains

Link-Belt Co., Indianapolis, has introduced a new line of chains for drives, elevators and conveyors operating under abrasive conditions; for chain drives where great strength is required; for drag, scraper and flight conveyors where the chain is subject to abrasion; and for heavy duty drives of comparatively high speed, short centers and large sprocket ratios.

The chains are made of a specially processed malleable iron developed by the research department of the company and sold under the trade name promal. The new iron is claimed to have the following average physical properties: Yield point, 45,000 pounds per square inch; ultimate strength, 65,000 pounds per square inch; elongation, 14 per cent; and brinell hardness, 170 to 190. It is tough and ductile and although high temperatures reduce the tensile properties slightly temperatures up to 1000 degrees Fahr. will not cause it



Chain Link Made from New Metal and Especially Applicable to Abrasive Installations

to become brittle. The accompanying illustration shows a chain link made of the new cast material.

Hoist Is Equipped with Electric Motor

Chisholm-Moore Hoist Corp., Tonawanda, N. Y., has introduced a new line of chain hoists equipped with electric motors. The hoists are designed to lift heavy and continuous loads quickly and are equipped with small lift wheels to give great lifting power. Features of the motors on the hoists are ball bearings and built-in magnetic brakes. The units are disassembled easily since they contain only 12 bolts.

The hoists are constructed in such a manner that they are adaptable to low head room. They are made with vertical rotating axis which make them adaptable to awkward positions. The units are balanced to eliminate unequal stresses on the supporting trolleys. They also are light in weight.

Designs Pillow Block

Link-Belt Co., Chicago, has placed on the market a new pillow block of the ball and socket type equipped with antifriction roller bearings. The new pillow block was designed several years ago and according to the manufacturer, in the meantime has been service-tested in a wide

The Unit May Be Disassembled Easily

variety of uses. The pillow blocks are designed to fit any good grade of commercial shafting, from 1 7/16-inch diameter to the largest size, without special fittings or the use of appliances. Pressure lubrication is used and the blocks are constructed to prevent the entrance of dust. The grease is forced in at the center and out at the shaft openings.

Mathematics
The Modern Sherlock

WOULD you be interested to know if variations in the carbon content of a large number of your steel heats are due to one cause or to accumulations of random variations inseparable from shop operations? How many rejected heats will you have when maximum and minimum carbon contents are specified? Can you determine whether your analyst is actually doing his work or do you resort to a run of check samples? Can you determine the reliability of data received from outside sources?

These and other applications of the theory of probability to the solution of everyday problems are explained in a concise, simple, and clear-cut manner in an article by H. A. Schwartz which will appear in the Aug. 15 issue of THE FOUNDRY. Only the practical applications which are illustrated graphically, will be described. The details of the theory and the mathematics involved are omitted. The article is readable, interesting and practical.

Equipment Orders Gain

After four months of steady decline the monthly index of gross orders for foundry equipment has turned upward in June, regaining a portion of the loss. The index for June at 102.1 is the lowest since July, 1928, according to the Foundry Equipment Manufacturers association. The three-month average of gross orders declined from 126.5 in May to 105.9 in June, index of shipments increased from 149.4 in May to 160.5 in June and index of unfilled orders shrank from 179.3 in May to 166.7 in June. Comparison of gross orders is as follows:

	1927	1928	1929	1930
Jan.	180.4	132.7	180.5	160.1
Feb.	198.0	123.6	197.0	196.4
Mar.	131.1	138.6	209.4	164.1
Apr.	130.1	107.7	172.6	122.8
May	13.8	325.6	177.7	92.7
June	138.4	149.1	177.3	102.1
July	89.9	94.8	218.6	.....
Aug.	106.4	278.0	229.5	.....
Sept.	80.4	170.0	216.3	.....
Oct.	98.0	185.0	245.3	.....
Nov.	95.8	197.8	128.6	.....
Dec.	106.8	166.5	208.0	.....

Base: Average monthly shipments for 1922-23-24 taken as 100.

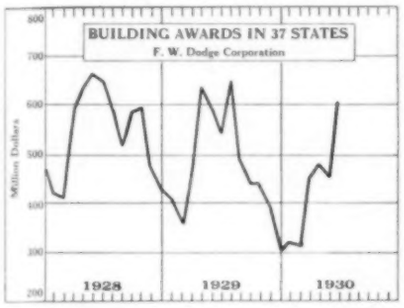
The corner stone of the new engineering laboratory of the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., was laid recently by W. S. Rugg, vice president of the company. The new building will contain 25 well equipped laboratories, one for nearly every branch of the electrical industry.

Trade Trends in Tabloid

JULY probably will mark the low point in foundry operations for 1930. Even with the general business depression supplemented by the normal seasonal decline, many exceptions are found to the low rate of operation which would be expected. Foundries making special castings for the chemical industry, a number of steel foundries engaged both in specialty and railway work are active.

—T—T—

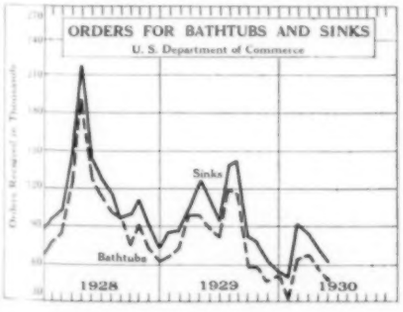
End of the period of depression probably is in sight, according to a survey conducted by the National Conference of Business Paper Editors. The opinion of 150 editors representing practically every branch of

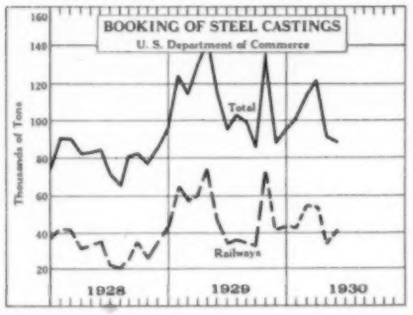


the industry, holds that September to November will show marked improvement in business. Inventories of raw materials in industrial plants, wholesale and retail stocks of commodities are low and are not being replenished. Manufacturers have no large stocks of goods to be unloaded. Although employment is off as much as 40 per cent in some industries, few, notably shipbuilding, chemical industry, oil and gas line construction and other activities are above normal.

—T—T—

Foundry operating schedules show further losses in the Chicago district. Operations for the district now are under 50 per cent. Demand for aluminum castings has been so light that casting schedules are estimated at the lowest point in about nine years. Some of the malleable plants report fair releases for August from automotive works, but





there are no signs to indicate a sustained demand.

—T—T—

Combined deliveries of brass and bronze ingots and billets declined 10.9 per cent in June according to the report of the Nonferrous Ingot Metal institute. Unfilled orders on July 1 showed an increase of 0.09 per cent over the June 1 figure.

—T—T—

Foundry operations in the lower lake regions as reflected by specifications for pig iron showed a decline during the early part of July. The impression prevails that this month will mark the low point of the year.

—T—T—

In the St. Louis district, with the exception of two or three stove foundries which have suspended for the last two weeks of July, operations are from three to five days per week. Stocks of finished stoves are not large and manufacturing for

RAW MATERIAL PRICES
July 22, 1930

Iron	
No. 2 foundry, Valley	$18.00
No. 2 Southern, Birmingham	14.00
No. 2 foundry, Chicago	18.00
No. 2 foundry, Buffalo	18.50
Basic, valley	18.00
Basic, Buffalo	18.00
Malleable, Chicago	18.00
Malleable, Buffalo	19.00
Coke	
Connellsville beehive coke	$3.50 to 4.85
Wise county beehive coke	4.25 to 5.00
Detroit by-product coke	8.50
Scrap	
Heavy melting steel, Valley	$14.75 to 15.25
Heavy melting steel, Pitts	14.50 to 15.00
Heavy melting steel, Chicago	12.00 to 12.25
Stove plate, Buffalo	10.50 to 11.00
Stove plate, Chicago	9.50 to 10.00
No. 1 cast, New York	9.50 to 9.75
No. 1 cast, Chicago	12.00 to 12.50
No. 1 cast, Philadelphia	13.50
No. 1 cast, Pittsburgh	14.00 to 15.00
No. 1 cast, Birmingham	12.00 to 13.00
Car wheels, iron, Pittsburgh	15.50 to 16.00
Car wheels, iron, Chicago	13.50 to 14.00
Railroad malleable, Chicago	13.50 to 14.00
Agricultural mal., Chicago	12.25 to 12.75
Malleable, Buffalo	15.00 to 15.50
Nonferrous Metals	**Cents per pound**
Casting, copper, refinery	10.87½
Electro, copper, producers	11.00 to 11.12½
Straits, tin	29.62½
Lead, New York	5.25
Antimony, New York	6.87½
Nickel, electro	35.00
Aluminum, No. 12, producers	22.00
Aluminum, No. 12, remelt	15.50
Zinc, East St. Louis, Ill.	4.40

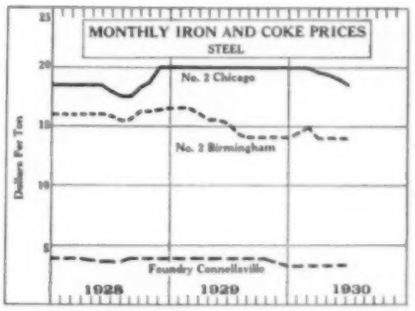
re-stocking purposes is in prospect on a large scale for September 1. Malleable foundries making railway and automobile work in the St. Louis district are slack, and no improvement is looked for before September 1.

—T—T—

The volume of contracts for new construction in 37 states east of the Rocky mountains was higher during June, according to F. W. Dodge Corp. Except for April and July of last year, June 1930 shows the highest total recorded in the past two years.

—T—T—

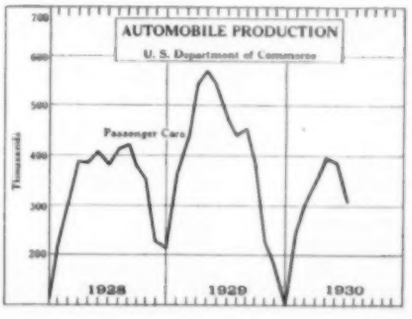
Automobile production showed a stronger decline in June, as will be



noted from the chart accompanying. The production of passenger cars in the United States and Canada totaled 301,989 in June compared to 384,287 in May and 452,749 in June, 1929. Truck production in June, 1930 was 48,667 compared with 93,183 in June, 1929.

—T—T—

Foundry operations in the Pittsburgh district have declined moderately over the past 30 days, with activity among steel foundries at a relatively better rate than that of iron foundries. The current melt is near the lowest level of the year. Schedules of iron foundries vary from two to five days a week. Sanitary ware producers continue light operations, usually working only half time. Radiator companies are slightly more active. Ingot mold production remains dull, although one plant that had suspended operations has resumed on light schedule.



What the Foundries Are Doing

Reflecting the Activities of the Gray Iron, Malleable, Steel and Brass Shops

Miller-Hillestad Foundry, Waterloo, Ia., recently was damaged by fire.

Decatur Casting Co., Decatur, Ind., has resumed operations following the annual vacation week shutdown.

Schaff's Foundry, 640 North Dorgenois street, New Orleans, is erecting an addition to its pattern shop.

New Haven Foundry, New Haven, Mich., has resumed operation following a shutdown for the installation of new machinery.

Caldwell Foundry & Machine Co., Birmingham, Ala., has added $50,000 to its life insurance coverages of employes, making a total of $150,000 now in force.

Titus Foundry Co., Coldwater, Mich., has been incorporated by L. C. and W. R. Titus to manufacture and deal in castings and parts.

Superior Foundry & Mfg. Co., Chattanooga, Tenn., has been incorporated with $10,000 capital by W. B. Looney, Andrew Jackson apartments.

Zandt Brass Foundry Co., 413 Railroad avenue, south, Seattle, has been incorporated with $15,000 capital by John Zandt to operate a foundry.

Buffalo Pipe & Foundry Corp., Buffalo, has been incorporated with $100,000 capital by Wilson & Van Allen, to operate a foundry.

A. Kilpatrick Sons Foundry Co., 625 East Carrie street, St. Louis, has been incorporated with $180,000 capital by Albert B. Kilpatrick, 3811 Greer street.

Efficient Foundry, New York, has been incorporated with $10,000 capital by G. G. Lake, 2 Lafayette street, to operate a foundry.

General Bronze Co., Grant building, Pittsburgh, will expand and improve its plants from a part of the proceeds of a $3,000,000 bond issue now being offered.

Chapman Valve Mfg. Co., Indian Orchard, Mass., has plans for a new steel foundry estimated to cost $65,000 and a valve shop to cost $30,000. (Noted June 1.)

Fremont Foundry Co., Trenton street, Tulsa, Okla., is erecting a foundry building, 50 x 60 feet, for the first unit of a gray iron foundry. R. B. Fremont is president and general manager.

L. S. Sayles Machine Co., Walpole, Mass., has been incorporated by Walter A. Rockwood and Stephen P. Guchman to engage in general manufacturing and foundry business.

Iroquois Foundry Co., Racine, Wis., has been incorporated with $15,000 capital by August C. Vierthaler, 317 Loudtke avenue, to engage in general foundry business.

Gillie Machine Co., Tonawanda and Chestnuts streets, Tonawanda, N. Y., is installing a monorail system in its foundry. Alfred J. Schwartz is general manager.

C. L. Knight Lumber & Box Co., Wichita, Kan., has purchased the Air Industries Foundry Co. from Stearman Aircraft Co. The new owners plan expansion of facilities.

Bechdolt Seeder Plow Co. Ltd., Medicine Hat, Alta, Can., has been incorporated with $100,000 capital by Fredrick Bechdolt and Edward Lust, to manufacture and deal in agricultural implements and to carry on the business of iron founder and metal worker.

Goslin-Birmingham Mfg. Co., Birmingham, Ala., recently acquired by the Whiting Corp., Harvey, Ill., is making extensions to its foundry and is said to have awarded some contracts.

Buffalo Bronze Die Cast Corp., 90 Arthur street, Buffalo, has a building permit for a 1-story machine shop. The company manufacturers aluminum bronze castings.

Lewisburg Stove Co., Lewisburg, Tenn., has resumed work after repairing that part of the plant recently damaged by fire. The plant also has been enlarged 30 feet in both dimensions. (Noted July 15.)

Bass Foundry & Machine Corp., 1602 Hanna street, Ft. Wayne, Ind., has filed new articles of incorporation to comply with recently enacted Indiana corporation laws. The company lists its paid-in capital at $1,000,000.

Atlas Steel Castings Co., Inc., 1963 Elwood avenue, Buffalo, has awarded the contract for the construction of a one-story addition to its plant. The new unit will be 24 x 60 feet and will be used as a cleaning department.

Standard Foundry Co., Southgate place and Armory street, Worcester, Mass., has acquired property adjoining its plant. The new acquisition formerly was owned by the Worcester Woolen Mill Co.

Farrell-Birmingham Co., Main street, Ansonia, Conn., plans the construction of a one-story plant addition and improvements in its present plant. Cost of new construction and equipment is estimated at approximately $45,000.

Pierce, Butler & Pierce Mfg. Corp., 41 East Forty-second street, New York, whose plant at Syracuse, N. Y., recently was damaged by fire, will receive bids soon for the construction of a new plant. The cost is estimated at $100,000. Plans are private. (Noted June 1.)

Sherman Machine & Iron Works, 18 East Main street, Oklahoma City, Okla., whose foundry recently was damaged by fire, has acquired a 250-foot tract west of the fair grounds between Eighth and Ninth streets. Approximately 70,000 square feet are available for foundry purposes.

United Nail & Foundry Co., St. John, N. B., is being formed by the merger of the Consolidated Foundry and St. John's Nail Mfg. Co., with a capitalization of $360,000. The new company is considering the expenditure of $60,000 for new plant and equipment. Future expenditures may total $100,000.

Williams Bros. Foundry, Elkhart, Ind., has purchased the Stanley Foundry Co., Grand Rapids, Mich., and will operate it as a branch to supply brass and aluminum castings to customers in the Michigan area. The Elkhart foundry specializes in musical instrument parts and the Grand Rapids branch will be devoted to building and furniture hardware.

Schultz Die Castings Co., Toledo, has acquired the plant of the Toledo Tap Co., 1810 Clinton street. Plant and equipment needs are to be filled before production begins about August 1. Equipment includes the machinery for a die shop, tool room and special machinery for the production of die castings. Total cost of machinery, tools, etc., will be over $150,000. (Noted July 15.)

Dallas Locomotive Co., Redding, Calif., is reported to have taken an option on the plant of the Johnson Iron & Brass Works, recently damaged by fire. Dallas company plans to remodel the plant and add equipment and machinery. Foundry and machine shops for overhauling locomotives will be operated and lumber carriers, prune stoves and other metal products will be manufactured.

Pettibone-Mulliken Co., Chicago, reports a gross income from operations of $442,508, and net income after expenses, taxes, depreciation and all charges of $30,480, over the period from Nov. 1, 1929 to April 30. Balance sheet as of April 30 reflects a strong financial position with total current assets of $2,089,011.

Taylor-Wharton Iron & Steel Co., High Bridge, N. J., will expand its foundry facilities. Contract for design and construction of the extension has been awarded to the Austin Co., Cleveland. Cost of the new construction will be approximately $300,000. Plans call for new sand handling and conditioning equipment. Buildings required will be 80 x 20 feet and 130 x 50 feet. Gray iron castings will be manufactured. G. R. Hanks is president of the company.

Trade Publications

GEARS—Boston Gear Works Sales Co., North Quincy, Mass., has issued a catalog listing and describing the gears, chains, bearings etc. that are carried in stock. Engineering data on the products are included.

V-BELT DRIVES — Worthington Pump & Machinery Co., Harrison, N. J., has issued a bulletin describing its new multiple V-belt drive. The illustration and description is concluded with a chart for the information needs in ordering.

LIFTING DEVICES—Ambold Machine Tool Corp., 50 Church street, New York, features its junior double-acting hoist in a current bulletin, with some mention of its other electrical lifting devices with capacities up to 10 tons.

HYDROGEN IONS — Leeds & Northrup Co., Philadelphia, has published a book of notes on the measurement of hydrogen ion concentration. The pamphlet is a brief text on the subject including fundamental information and details of the methods used for the determinations.